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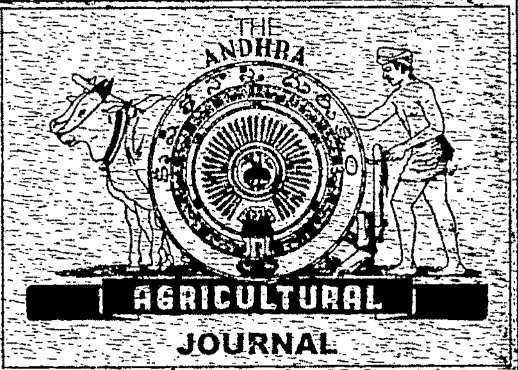

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Yield and Nitrogen Uptake of Residual Wheat in Rice - Wheat Cropping System as Influenced by Greenmanures

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ABSTRACT

Influence of greenmanure on yield and N uptake of residual wheat was studied under greenhouse condition. Three urea enriched greenmanures, *viz.*, dhaincha *(Sesbania aculeata L.)*, cowpea (*Vigna unguiculata L.*) and guar (*Cyamopsis teragonoloba L.*) and split application of urea was compared under rice - wheat cropping sequence. Residual effect of greenmanures and their enriched counter parts in terms of yield and N uptake of wheat was better than that of urea treated soil during preceding rice season. Negative correlation existed with both lignin content and C/N ratio whereas positive correlation existed with N content of greenmanures with grain yield, dry matter yield, grain N uptake and total N uptake of residual wheat. Efficiency of residual N utilization in terms of grain yield, dry matter yield, grain N uptake and total N uptake by wheat could be determined by the N content, lignin content and C/N ratio of greenmanures. Lignin content was found to be a better index than N content and C/N ratio in predicting the grain yield, dry matter yield, grain N uptake and total N uptake of residual wheat. The linear regression equations involving lignin content could effectively describe 80.78 to 87.35 per cent of total variations in grain yield, dry matter yield, grain N uptake and total N uptake of residual wheat.

Key words : C/N ratio, Enriched Greenmanure, Lignin, N content, Rice, Wheat.

Arresting yield decline and maintaining soil fertility on a long-term basis in rice-wheat cropping sequence has become a problem because of too much reliance on chemical fertilizer and organics particularly greenmanures have been sought to be the answer. Moreover, rice-wheat cropping system places an extraordinary stress on soil and warrant for adequate supply of the prime yield-limiting nutrient like N. Besides edaphic and management factors, properties of greenmanures also influence N supplying capacity and ultimately yield and N uptake of residual crop grown in sequence. Yield and N uptake by succeeding crop have generally been used as an index of residual effect of added N to the preceding crop. It was, therefore, considered worthwhile to evaluate the influence of the N content, lignin content and C/N ratio of greenmanures applied to rice on the yield and N uptake of residual wheat in rice-wheat cropping system.

MATERIAL AND METHODS

A greenhouse experiment was conducted at Indian Agricultural Research Institute, New Delhi with rice-wheat cropping system on a Typic Ustochrept soil with textural class loam, pH (1:2, soil : water) 8.3, EC (1:2, soil : water) 0.2 dS m^{-1}, organic carbon 4.1 g kg^{-1}, available N 212 kg ha^{-1}, available P 19 kg ha^{-1}, available K 209 kg ha^{-1}, CEC 8.1 cmol (p^+) kg^{-1}, total organic N 579 mg kg^{-1}, hydrolysable N 441 mg kg^{-1}, non-hydrolysable N 138 mg kg^{-1}, and inorganic N 29.02 mg kg^{-1} during 1992 and 1993. Soil moisture content at -0.03 MPa and -1.5 MPa

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Table 1 : Chemical composition of greenmanures

Properties	Dhaincha			Cowpea			Guar		
	E_0	E_1	E_2	E_0	E_1	E_2	E_0	E_1	E_2
Nitrogen (mg g^{-1})	20.3	21.2	23.5	15.6	17.8	19.8	27.5	28.3	30.1
Phosphorus (mg g^{-1})	2.2	2.6	2.8	2.6	2.5	2.8	2.3	2.7	2.5
Potassium (mg g^{-1})	20.2	20.3	21.2	21.7	21.2	21.8	20.2	19.8	21.3
Carbon (mg g^{-1})	421	420	420	444	445	440	420	421	419
Hydrogen (mg g^{-1})	59.8	62.0	60.3	60.8	62.1	61.7	59.0	61.1	60.9
Cellulose (mg g^{-1})	78.0	77.6	79.5	65.1	67.6	70.1	80.1	77.9	80.3
Lignin (mg g^{-1})	170.1	169.2	165.0	175.0	178.0	171.0	166.0	161.0	158.0
C/N ratio	20.74	19.81	17.87	28.46	25.00	22.22	15.27	14.88	13.92

were 21.5 and 7.5 per cent, respectively. Three popular greenmanures, *viz.*, dhaincha, cowpea and guar were grown for 50 days with 0,10 and 30 kg N ha^{-1} as starter dose. To enrich (E) the greenmanures, in order to narrow down the C/N ratio, 0,1 and 3 per cent urea solutions were spread on greenmanures grown on 0,10 and 30 kg N ha^{-1}, respectively. Three sprayings on alternate days from fourteenth to tenth days before incorporation of greenmanures were done to get enrichment levels of E_0, E_1 and E_2, respectively. Among the chemical composition of greenmanures (Table 1), carbon and hydrogen were estimated by dry combustion method as per Culmo (1969), N by Kjeldahl method of AOAC (1960); phosphorus and potassium as per Yoshida *et al.* (1976); cellulose and lignin were estimated as per the method described by Van Soest (1963). Crop response and efficiencies of these organic sources were compared with split application (1/2 at transplanting + 1/4 at 30 days after transplanting (DAT) + 1/4 at 65 DAT) of urea. Each of the ten sources of N were applied at the rate of 60 (L_1). 120(L_2) and 180(L_3) kg ha^{-1} (soil weight basis), ten days before transplanting (30 days old seedling) of rice (cv. Pusa Basmati-I) in glazed porcelain pots of 4 kg capacity. At the time of transplanting, 40 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1} were applied (soil weight basis), through aqueous solution of KH_2PO_4 and KCl, respectively. Wheat (cv. HD 2329) was grown on residual N status along with uniform basal application of 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1}. The experiment was laid out in completely randomized block design with three replications.

RESULTS AND DISCUSSION

Effect of organic and inorganic N on rice

Nitrogen application, irrespective of sources and levels produced higer grain and dry matter yield, N content and N uptake of rice than that of control (Table 2). Response of N increased significantly with increasing level of N upto 180 kg N ha^{-1}. On the other hand, interaction between sources and levels of N was significant only in case of grain and total N uptake. Significant difference between urea and green manures (when grouped together) was noticed only for N uptake by rice. Enrichment of green manures was found to have significant influence on yield, N content and uptake of rice.

Effect of residual N on wheat

Yield and uptake by succeeding crop have generally been used as an index of residual effect

Table 2 : Grain yield and N uptake of rice

Treatment	Yield (g pot^{-1})		N Content (%)		N uptake (mg pot^{-1})		
	Grain	Dry matter	Grain	Straw	Grain	Straw	Total
Sources							
Urea	10.3	21.0	1.23	0.46	128.5	49.9	178.4
Dhaincha	8.3	18.0	1.19	0.46	100.3	45.2	145.4
Cowpea	7.9	16.9	1.18	0.45	94.5	40.3	134.8
Guar	9.4	19.6	1.21	0.46	114.8	47.7	162.5
Control	4.1	10.4	1.03	0.41	42.3	25.6	68.0
Enrichment level							
E_0	8.6	18.2	1.19	0.46	103.2	45.0	147.6
E_1	9.3	19.0	1.23	0.47	114.7	46.4	161.2
E_2	10.0	20.0	1.25	0.49	126.3	53.7	176.7
N level :							
L_1	7.0	15.8	1.15	0.43	80.4	38.3	118.7
L_2	9.7	19.6	1.23	0.48	119.0	47.9	166.9
L_3	11.5	22.7	1.29	0.50	148.9	55.9	204.8
CD (P = 0.05)							
Control vs rest	0.37	2.90	0.04	0.02	4.49	1.10	14.81
Urea vs greenmanure	NS	NS	NS	NS	2.59	0.64	8.55
Enrichment	0.19	0.95	0.10	0.01	1.50	0.37	0.54
Level	0.15	0.90	0.02	0.02	1.42	0.35	4.68
Source X level	NS	NS	NS	NS	4.49	NS	14.81

of added N to the preceding crop. The beneficial effect of added N in the preceding rice season to the succeeding wheat crop was apparent in the present investigation from the fact that the N amended soil recorded significantly higher grain and dry matter yield than control (Table 3). Greenmanures were found to be more beneficial than urea. Application of N to preceding rice resulted in a significant increase in grain and straw N content of wheat over control. Amongst the greenmanures, guar was found to be superior to others in increasing the N content. A steady response was observed with the increase in enrichment level of greenmanures. This might be attributed to release of more inorganic N from residual organic pool of amended soil than that of un-amended soil. Residual effect of greenmanures was found to be more than that of urea as was evidenced by the increase in grain and dry matter yield as well as grain and total N uptake (Table 3). Total N uptake and the uptake by grain were highest with guar followed by dhaincha and cowpea. Significant response was observed with the increase in the level of enrichment of greenmanures. Positive effect of greenmanures to the succeeding crop when applied to the preceding rice season was also observed by Bharadwaj and Dev (1985) and Zhu *et al.* (1984).

Correlation and regression analysis

Amongst the greenmanure properties, N content, lignin content and C/N ratio were found to be significantly (P = 0.01) correlated with grain yield, dry matter yield, grain N content and total N uptake of residual wheat. N content of

Table 3 : Grain yield and N uptake of residual wheat

	Yield (g pot^{-1})		N Content (%)		N uptake (mg pot^{-1})		
Treatment	Grain	Dry matter	Grain	Straw	Grain	Straw	Total
Sources :							
Urea	4.20	8.48	1.08	0.47	45.37	20.01	65.37
Dhaincha	4.34	8.76	1.12	0.48	48.86	21.40	70.27
Cowpea	4.28	8.65	1.11	0.47	47.40	20.70	68.10
Guar	4.41	8.90	1.13	0.49	50.11	21.98	72.09
Control	3.28	6.65	0.93	0.42	30.50	14.15	44.65
Enrichment level :							
E_0	4.29	8.66	1.10	0.48	47.46	20.93	68.40
E_1	4.34	8.75	1.12	0.48	48.75	21.26	70.00
E_2	4.40	8.89	1.14	0.49	50.16	21.89	72.06
N level :							
L_1	3.99	8.10	1.09	0.46	43.49	19.00	62.49
L_2	4.33	8.73	1.12	0.48	48.47	21.16	69.63
L_3	4.66	9.38	1.15	0.50	53.39	23.52	76.90
CD (P = 0.05)							
Control vs rest	0.11	0.52	0.027	0.015	1.400	0.616	1.610
Urea vs greenmanure	0.06	0.30	0.016	0.009	0.809	0.356	0.930
Enrichment	0.04	0.17	0.009	0.005			0.970
Level	0.03	0.16	0.009	0.005	0.443	0.195	0.509
Source X levle	NS	NS	NS	NS	NS	NS	NS

greenmanures was found to be positively correlated (P = 0.01 with grain yield (r = 0.859), dry matter yield (r = 0.838), grain N content (r = 0.659) and total N uptake (r=0.836). On the other hand, lignin content of greenmanures was foud to be negatively correlated (P = 0.01 with grain yield (r = -0.935), dry matter yield (r = -0.932), grain N content (r= -0.899) and total N uptake (r=-0.858). Similarly, the C/N ratio of the greenmanures was found to be negatively correlated (P=01) with grain yield (r=0.864), dry matter yield (r=0.847), grain N content (r=-0.864) and total N up take (r=-0.858). This may be attributed to the fact that cumulative N mineralization was positively correlated with N content whereas negative correlation existed with lignin content and C/N ratio of greenmanures (Dey and Jain, 1997).

To assess the effect of greenmanure properties towards the yield and nutrition of residual wheat, linear model was fitted with properties of greenmanures (X) and yield and N uptake (Y) of wheat. Amongst the greenmanure properties, N content, lignin content, C/N ratio could significantly (P=0.01) describe the variations in grain yield, dry matter yield, grain N content and total N uptake of residual wheat. Nevertheless, it is evident that the effect of greenmanure properties on residual wheat can be best described by the lignin content and the equations involving lignin can effectively explain 87.35, 86.93, 80.78 and 85.14 per cent of total variations in grain yield, dry matter yield, grain N uptake and total N uptake of residual wheat. Therefore, lignin content of greenmanures could be effectively used as an indicator for the prediction of yield and N uptake of residual wheat crop.

From the above results, it can be concluded that enrichment of green manures was found to have significant influence on yield, N content and uptake of rice. The residual effect of greenmanures on wheat was more than urea. Negative correlation existed with both lignin content and C/N ratio whereas positive correlation existed with N content of greenmanures with the grain yield, dry matter yield, grain N uptake and total N uptake of residual wheat. Efficiency of residual N utilization in terms of grain yield, dry matter yield, grain N uptake and total N uptake by succeeding wheat can be determined by the properties of greenmanure and lignin content was the best indicator.

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Effect of Nitrogen Fertilization on the Yield of Finger Millet (*Eleusine coracana* (L.) Gaertn.) Varieties Under Rainfed Condition

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ABSTRACT

A field experiment was conducted during *kharif* seasons of 1997 and 1998 to study the comparative efficiency of different levels of nitrogen on the yield of finger millet under rainfed condition. The results showed that the variety Sapthagiri proved superior to PPR 2679 and PPR 2709, with regard to seed yield. Finger millet varieties responded significantly upto 40 kg N ha^{-1} under rainfed condition. The economic optimum level of N was worked out to be 46.8 and 55.5 kg N ha^{-1} during 1997and 1998, respectively.

Key Words : Fertilization, Finger Millet, Rainfed, Sapathagiri, PPR 2679, PPR 2709.

Fertilizer use to increase crop yield is an important input in agro-practices for crop production. Finger millet is one of the most important dry land crops of Southern Agro-climatic Zone of Andhra Pradesh and it is grown on marginal lands under neglected conditions with low yield level. In Southern Agro-climatic Zone of A.P., this crop has an area of 17,000 ha with an average yield of 1120 kg ha^{-1} which is much low as compared to the national average of 1440 kg ha^{-1} (SAI, 1997). The yield of this crop can be increased by selection of suitable high yielding veriety with proper fertilizer management especially, nitrogen even under rainfed condition. The common belief that it may not profitably respond to applied nutrition does not hold true. Several workers (Prakash *et al.,* 1989; Rao *et al.,*1989; Singh and Arya, 1994) reported that application of fertilizer nitrogen had a beneficial effect on yield of finger millet under rainfed condition. It is, therefore, pertinent to study the nutrient needs of these high yielding varieties in the context of fast changing cropping pattern in the Southern Agro-climatic zone of Andhra Pradesh.

MATERIAL AND METHODS

An experiment was conducted on sandy loam soil of Regional Agricultural Research Station, Tirupati during *kharif* seasons of 1997 and 1998 with the varieties, PPR 2679, PPR 2709 and Sapthagiri and four levels of nitrogen (0, 20, 40 and 60 kg ha^{-1}) The experiment was laid out in randomized block design and the treatments were replicated thrice. The soil of the experimental field contained low available nitrogen (110 kg ha^{-1}) medium available phosphorus (45.1 kg P_2O_5 ha^{-1}) and high available potash (452 kg K_2O ha^{-1}) with neutral reaction (7.1) and low in organic carbon content (0.292%). Direct seeding was done on 10 - 8 -1997 and 20 - 7 -1998 during 1997 and 1998, respectively, adopting a spacing of 22.5 cm x 10 cm. Thinning was done at 10 days after sowing keeping one healthy seedling per hill. Half of the dose of N as per the treatment and full dose of phosphorus (P_2O_5) and potash (K_2O) each at 20 kg ha^{-1} were applied at the time of sowing. The remaining half dose of N as per the treatment was top dressed three weeks after

Table 1 : Meteorological observations during *kharif* 1997 and 1998

	1997					1998				
	Temp. (°C)		Relative Humidity (%)	Sunshine (h / day)	Rainfall (mm)	Temp. (°C)		Relative Humidity (%)	Sunshine (h / day)	Rainfall (mm)
	Max.	Min.				Max.	Min.			
July	35.8	26.6	61	5.2	65.6	35.1	25.3	72	3.8	107.0
August	34.4	25.9	64	5.7	58.5	32.5	24.5	82	4.1	224.1
September	33.4	24.8	73	6.5	104.7	32.0	24.2	83	4.2	156.0
October	32.9	22.7	77	7.9	111.8	30.6	22.7	85	3.8	91.0

sowing. All other cultural practices were followed to raise good crop. The crop was harvested on 10 -11- 1997 and 12 - 10 -1998 during 1997 and 1998, respectively.

A response curve was fitted for the nitrogen levels using the quadratic equation.

$$\bar{Y} = a + bx - cx^2$$

Where $\bar{Y}$ = expected yield,

x = level of nitrogen (kg ha^{-1}) and a,b,c are constants. The optimum dose was worked out by the formula

$$x = 1(q/p - b) / 2c$$

Where, x is optimum dose of N, b and c are constants of quadratic response curve, p is the price per kg of produce and q is the cost per kg of nitrogen.

The rainfall received during crop growth period was 340.6 mm and 578.1 mm in 1997 and 1998, respectively. The distribution of rainfall by and large was uniform in 1998 and led to better growth and yield of crop. However, in 1997, the inadequate rainfall and prolonged dry spells coincided tillering and grain filling stages and led to poor performance of the crop. The meteorological data for 1997 and 1998 are furnished in Table 1.

RESULTS AND DISCUSSION

Effect of cultivars

Plant height, number of effective tillers m^{-2}, number of fingers ear^{-1} and weight of the ear and weight of 1000 seed altered significantly under different finger millet cultivars (Table 2). Sapthagiri produced significantly taller plants, more number of effective tillers m^{-2}, more number of fingers ear^{-1}, higher weight of the ear and 1000 seed weight than those of PPR 2679 and PPR 2709. The differences in the yield attributes between PPR 2679 and PPR 2709 were statistically at par. Sapthagiri yielded significantly higher grain and straw than PPR 2679 and PPR 2709, but the latter two were on a par with each other. The average percentage increase in yield of Sapthagiri was 21 and 23 in 1997 and 1998, respectively, over other varieties. The higher productivity of Sapthagiri was mainly due to higher values of yield attributes over the other two varieties (AICRP on Millets, 1996).

Effect of nitrogen

Application of nitrogen upto 60 kg ha^{-1} increased the values of all growth characters *viz.* plant height, number of effective tillers m^{-2}, number of fingers ear^{-1}, weight of the ear and 1000 - seed weight (Table 2). It is further noticed that 40 kg N ha^{-1} showed a progressive and significant increase over the preceding levels

Table 2 : Growth, yield and yield attributes of finger millet varieties as influenced by nitrogen levels.

Treatment	Plant height at harvest (cm)		Number of effective tillers m^{-2}		Number of fingers / ear		Weight of ear (g)		1000 - seed weight (g)		Seed yield (kg ha^{-1})		Straw yield (kg ha^{-1})	
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
Varieties														
PPR 2679	55.1	88.4	159	202	7.06	7.83	21.5	23.4	3.29	3.35	1018	1822	1527	3097
PPR 2709	51.9	84.4	153	197	6.40	7.53	20.1	22.8	3.07	3.15	1007	1895	1510	3221
Sapthagiri	82.3	100.8	184	234	8.56	11.40	29.6	31.7	3.41	3.81	1288	2346	1932	3988
C.D. at 5%	6.8	2.7	8.7	28.6	1.06	0.55	1.20	1.52	0.04	0.05	174	98	261	166
Nitrogen level (kg ha^{-1})														
0	52.8	81.5	134	153	5.66	7.84	20.1	22.3	3.10	3.26	816	1432	1101	2427
20	61.2	91.2	164	197	6.95	8.63	23.4	25.3	3.23	3.40	1056	1975	1580	3354
40	68.5	95.8	180	241	8.21	9.39	25.6	27.5	3.34	3.50	1246	2298	1927	3920
60	70.6	97.1	185	256	8.47	9.80	26.1	28.5	3.35	3.53	1298	2377	2015	4036
C.D. at 5%	7.1	3.1	10.1	33.1	1.22	0.64	1.35	1.72	0.05	0.06	201	112	301	190

with respect to all characters studied, but the effect of N beyond 40 kg ha^{-1} was not significant. The increase in growth and yield attributes may be due to better uptake of plant nutrients to the growing plants and reproductive sites. Papondick *et al.* (1971) opined that higher N application provides congenial surrounding for better root growth and distribution which enhances the scope to explore the nutrients from the greater soil volumes.

The grain yield increased correspondingly with increasing levels of N from 20 to 60 kg ha^{-1}. However, significant increase in grain yield was observed only upto 40 kg N ha^{-1} in both the years. Similar trend was observed with regard to straw yield. Prakash *et al.* (1989), Rao *et al.* (1989) and Singh and Arya (1994) also recorded higher grain yield with higher dose of nitrogen.

The average response to nitrogen levels was of the second order of polynomial equation.

$$Y = 727.5 + 22.96x - 0.227x^2 \text{ (1997)}$$

$$Y = 1330.7 + 32.24x - 0.275x^2 \text{ (1998)}$$

Considering the input output relations the most profitable dose of nitrogen was worked out to be 46.8 and 55.5 kg N ha^{-1} and the optimum yields at this level was 1304 and 2275 kg ha^{-1} during 1997 and 1998, respectively.

On perusal of grain yield data, it was observed that the yield level in 1998 was about two fold than in 1997, which was due to inadequate rainfall subjecting the crop plants to moisture stress. The moisture stress increases soil strength, decreases root growth and its proliferation, thereby decreasing the absorption of nutrients (Taylor and Gardner 1960) and leading to lower yields. However, in the second year with good and well distribution of rainfall the physical condition and the environment of the soil was better for more availability of moisture, which caused higher uptake of nutrients by plants and led to good yields.

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Relative Efficiency of Soil Solarization and Herbicides for Weed Control in *kharif* Blackgram

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ABSTRACT

An investigation was carried out to study the relative efficiency of solarization and herbicides on weed control and yield of blackgram at the Agricultural College Farm, Bapatla during *kharif* season of 2000. The magnitude of raise in the soil temperature by solarization treatments ranged from 10 to 12 °C and 5 - 8 °C due to transparent polyethelene sheets of 0.05mm and 0.1mm, respectively over non-solarized treatments. Dry matter production, number of pods per plant and seed yield per plant obtained due to weed free condition was significantly higher and was followed by two hand weedings at 20 and 40 DAS. Early post emergence application of imazethapyr @ 1.0 kg a.i. ha^{-1} recorded higher seed yields compared to pre-emergence application of benthiocarb @ 0.5 kg a.i. ha^{-1} and pre-plant incorporation of fluchloralin @ 1.0 kg a.i. ha^{-1}.

Key Words : Soil Solarization, Herbicides, Blackgram.

Blackgram is an important pulse crop of Andhra Pradesh, cultivated in an area of 4.30 lakh hectares producing 2.62 lakh tones with an average productivity of 609.1 kg ha^{-1}. Weed competition is a serious factor limiting the yield of blackgram especially during *kharif* season and soil solarization is a new soil disinfestation method for controlling soil born pathogens and weeds, mostly as a pre-planting treatment. Soil solarization is achieved by covering the soil with polyethelene sheets during the hot summer, thereby heating the soil and killing the pests. Imazethapyr is a new herbicide gaining importance for weed control in pulses which is comparable with pre-emergence application of benthiocarb @ 1.0 kg a.i. ha^{-1} and fluchloralin @ 1.0 kg a.i. ha^{-1} as pre-plant incorporation and hand weeding.

MATERIAL AND METHODS

The experiment was conducted during *kharif* 2000 at the Agricultural College Farm, Bapatla. The experimental soil was clayey with a pH of 7.95, low in organic carbon content (0.65%) and with 0.6 dSm^{-1} electrical conductivity. The available N, P_2O_5 and K_2O contents were 282.2 (medium), 41.0 (medium) and 565 kg ha^{-1} (high), respectively. Nine weed control treatments were laid out in randomized block design with 4 replications with a plot size of 4.8 x 3.0 m^2.

Treatment Details

T_1 - Control i.e. unweeded check

T_2 - Weed free (Weed free condition maintained by hand weeding at weekly interval upto 60 DAS).

T_3 - Soil Solarization with 0.05 mm thick transparent polyethelene sheet.

T_4 - Soil Solarization with 0.1mm thick transparent polyethelene sheet.

T_5 - Hand weeding at 20 DAS

T_6 - Hand weeding at 20 and 40 DAS

T_7 - Benthiocarb @ 0.5 kg a.i.ha^{-1} (Pre-emergence application)

T_8 - Fluchloralin @ 1.0 kg a.i. ha^{-1} (Pre-plant incorporation)

T_9 - Imazethapyr @ 0.1 kg a.i. ha^{-1} (early post-emergence application)

The urdbean variety LBG - 20 was sown on 27-7-2000 adopting a seed rate of 20 kg ha^{-1}, at 30 cm row spacing with a recommended dose of 20 kg N and 40 kg P_2O_5 ha^{-1}, respectively. The observations on yield and yield attributes were recorded at the time of harvest and soil temperature was measured (4 times) at weekly interval during soil solarization (21-5-2000 to 21-6-2000).

RESULTS AND DISCUSSION

The dominating weed flora observed in the experimental field was *Cyanodon dactylon, Digitaria sanguinalis* and *Eragostris minor* (grasses), *Cyperus rotundus* and *Cyperus difformis* (sedges) and *Trianthema portulacastrum, Euphorbia hirta and Commelina benghalensis* (dicots).

Density of Weeds

The total weed population was lower under weed free treatment (24.0 m^{-2}) followed by two hand weedings at 20 and 40 DAS while, significantly the highest population of weeds was observed under control. The total weed population recorded with early post-emergence application of imazethapyr @ 1.0kg a.i. ha^{-1} was

Table 1 : Effect of weed control methods on weeds and seed yield of blackgram

Treatments	Weed population at 45 DAS (No. m^{-2})	Weed dry matter at maturity g.m^{-2}	Weed control efficiency	No. of pods plant^{-1}	No. of seeds pod^{-1}	Seed yield plant^{-1} (g)	Test weight (g)	Seed yield kg ha^{-1}
T_1	16.62* (276.0)	62.50	-	8.5	5.8	1.7	38.6	564
T_2	4.94* (24.0)	11.6	98.0	16.8	6.3	4.0	39.4	1332
T_3	12.74* (162.0)	37.8	65.0	11.4	6.2	2.5	38.7	834
T_4	14.01* (196.0)	38.6	61.0	11.1	6.1	2.4	38.7	802
T_5	10.60 (140.0)	38.8	60.0	12.8	6.2	2.8	38.9	940
T_6	6.36* (40.0)	32.2	93.0	15.6	6.3	3.7	39.0	1222
T_7	14.94* (223.0)	39.8	56.0	9.7	6.0	2.2	38.8	720
T_8	11.76* (138.0)	37.0	68.0	14.1	6.3	3.2	38.8	1076
T_9	11.20* (125.0)	36.1	72.0	15.4	6.3	3.6	39.2	1210
SEm ±	0.62	1.22	0.90	0.45	0.06	0.07	0.23	33.5
CD (P = 0.05)	1.81	2.56	2.70	1.01	0.20	0.22	N.S	97.8

Table 2 : Influence of Soil Solarization treatments on Soil temperature (°C) at 5 cm depth of soil at weekly intervals.

Treatments	Soil Temperature (°C)			
	1	2	3	4
Control	34.0	33.6	31.7	31.5
Soil Solarization with 0.05mm thick TPS	46.7	43.7	43.2	41.0
Soil Solarization with 0.1mm thick TPS	39.5	38.1	37.8	36.7

TPS - Transparent polyethelene sheet

significantly lower compared to the other two herbicides, fluchloralin and benthiocarb (Table 1). The effective reduction in weed density by the two hand weedings at 20 and 40 DAS in blackgram was also reported by Gogoi *et al.* (1991) and Saraswat and Mishra (1993).

Dry matter of Weeds

At maturity the dry matter accumulation of weeds was significantly higher in weedy check followed by benthiocarb application @ 0.5 kg a.i. ha^{-1} (39.8 gm^{2}), while, the treatments T_3, T_4 and T_5 were at a par among them. The lowest weed dry matter was accumulated (0.5 g m^{-2}) with weed free treatment followed by two hand weedings at 20 and 40 DAS (32.2 g m^{-2}), respectively. Soil solarization either with 0.05 mm thick or 0.1 mm thick transparent polyethylene sheets resulted in significantly lower dry matter accumulation which may be attributed to the reduced weed population observed in these treatments.

Significantly higher (16.80) and lower (8.5) number of pods per plant were recorded with weed free and unweeded check treatments, respectively (Table 1), whereas early post-emergence application of imazethapyr @ 0.1 kg a.i. ha^{-1} was at a par with two hand weedings at 20 and 40 DAS. The number of seeds pod^{-1} was higher with weed free condition, which was comparable to T_6, T_8 and T_9 treatments.

Yield attributes and yield

Maximum seed yield plant^{-1} was observed with weed free treatment (T_2). Significantly higher seed yield plant^{-1} was recorded with hand weeding twice at 20 and 40 DAS (3.66) and this treatment was statistically equivalent to early post-emergence application of imazethapyr @ 0.1 kg a.i. ha^{-1}. Test weight (1000 seed weight) of blackgram crop was not significantly influenced by methods of weed control. These findings are in accordance with Srinivasa Rao (1993). The highest seed yield (1332 kg ha^{-1}) was recorded with T_2 treatment (Table 1). The drastic reduction in weed count and weed dry weight achieved by this treatment might have resulted in better availability of resources like moisture, nutrients and light which inturn improved yield components and yield.

Lowest weed index (8.27%) was obtained with two hand weedings at 20 and 40 DAS which was significantly superior to the treatments except T_9 where, both were at par. Higher weed index (45.9%) was obtained with benthiocarb @ 0.5 kg a.i. ha^{-1}. This may be attributed to the severe crop weed competition offered by the weeds to this treatment which inturn negatively influenced the yield and yield attributes. The results are in corroboration with the findings of Govinda Singh *et al.* (1992) and Kumar and Singh (1985).

Effect of Solarization treatments on soil temperature (°C) at 5 cm depth

Higher soil temperatures were recorded with soil solarization treatments i.e. soil solarization with 0.05 mm and 0.1mm thick transparent polyethelene sheet, (T_3 and T_4 Treatments). Higher soil temperature (10-20°C) was observed with T_3 treatment whereas 5.8 °C increase was recorded with T_4 treatment (Table 2). These results are in confirmation with

Chauhan *et al.* (1988) and Ajay Arora (1998). The supremacy of transparent polyethelene in raising soil temperature to higher magnitudes could be due to its maximum transmittance of the incoming shortwave radiation. It was also seen that thinner transparent polyethelene sheet is comparatively more effective than thicker polyethelene owing to its higher radiation transmittance. These findings agree with Emani (1991) and Subhashkumar and Yaduraju (1997). From the above discussion, it is concluded that hand weeding twice at 20 and 40 DAS and imazethapyr 0.1 kg a.i. ha^{-1} were comparable and give better blackgram growth, yield attributes and yield.

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Grain Quality of Rice as Affected by Varieties and Nitrogen Source

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ABSTRACT

An experiment involving application of various nitrogen sources was carried out using different rice varieties. Grain quality characteristics like, head rice recovery, grain length and breadth, protein content and amylose content, were the highest with the variety BPT 5204 and the Integrated use of 50% nitrogen through inorganic source (urea) and organic sources (FYM + Green manure). The yield and N-uptake of variety NLR - T 145 showed significant superiority over the other varieties.

Key Words : Quality, Rice Varieties, Nitrogen, Amylose, Proten.

Integrated Nutrient Management (INM) concept involving use of inorganic and organic sources in the most efficient manner has been known to reinforce the efficiency of both these sources resulting in higher productivity and quality. Varying levels of success with INM concept based on involving different manures, bio-fertilizers and chemical sources has been realized in low land rice (Gaur and Singh, 1982). Organic manures like, green manure, farm yard manure not only increase the yield but also improve the quality and taste of the produce (Koshino, 1990). A complementary case of organic manures and chemical fertilizers may probably increase the efficiency of both of these inputs and produce quality grain with much environmental safety. A demand for high quality rice in the market has prompted close co-operation among the rice breeders and cereal chemists. Agronomist should also tailor the management practices to realize the genetic patent for quality of the cultivars in the field.

MATERIAL AND METHODS

An experiment was conducted during *kharif* 2000 - 2001 at Agricultural College farm, Bapatla. The soil was a sandy clay loam (Sand 38.3%, Silt 24.7% and clay 37%) with pH 8.4, organic carbon 0.9%, and available N, 222.6 kg ha^{-1}. Twenty eight day old seedlings were transplanted in 3.9 x 1.8 m plots with a spacing of 20 x 10 cm. The experiment was laid out in randomized block design with factorial concept replicated thrice. The factor - A consisted of four rice varieties (MTU 2067, MTU 4870, BPT 5204 and NLR - T - 145) and factor - B consisted of four nitrogen sources (no nitrogen, 50% nitrogen through fertilizer (Urea) + 50% nitrogen through organic source (FYM + Green Manure), 75% nitrogen through fertilizer (urea) + 25% nitrogen through organic source (FYM + Green Manure) and 100% nitrogen through fertilizer (urea). An uniform dose of 100 kg N, 60 kg P_2O_5 and 40 kg K_2O ha^{-1} was applied. Entire P_2O_5 and K_2O were applied basally to all the treatments duly taking into consideration the phosphorus and

Table 1: Grain yield (kg ha^{-1}), straw yield (kg ha^{-1}) and Harvest index of rice as influenced by varieties and nitrogen sources.

Treatments	Grain Yield (kg ha^{-1})	Straw Yield (kg ha^{-1})	Harvest Index (%)
Varieties			
V_1 :MTU 2067	4262	5179	45.1
V_1 :MTU 4870	4359	4237	45.4
V_1 :BPT 5204	3513	4505	43.8
V_1 :NLR - T - 145	5188	5778	46.8
Nitrogen Sources			
N_0 :No Nitrogen Application	2364	3081	43.4
N_1 :50% nitrogen through fertilizer + 50% nitrogen through (FYM + green manure)	5751	6590	46.0
N_2 :75% nitrogen through fertilizer + 25% nitrogen through (FYM + green manure)	5214	6120	46.0
N_3 :100% nitrogen through fertilizer	4594	5436	45.8
SEm±	188	171	0.8
C.D. (0.05)	542	493	1.8
Interaction			
Varieties X Nitrogen Sources	NS	NS	NS

NS : Non significant

FYM : Farm yard manure

potassium content of the two organic sources, which were incorporated into the soil. Nitrogen was applied as per the treatments in three split doses of 50% basal and 25% each at active tillering and panicle initiation stages. Recommended agronomic practices and plant protection measures were followed.

Plant samples were collected at three stages and total N was determined by the Micro kjeldhal method (Jackson, 1973). The grain samples which were properly dried and processed, were taken for the assessment of quality of rice. Grain length and breadth were measured using the dial micrometer. The chemical quality parameters like amylose (Sadasivam and Manikam, 1992) and protein content (AOAC, 1980) were analysed. Cooking character like volume expansion ratio was determined as suggested by Murthy (1965).

RESULTS AND DISCUSSION

Grain yield and straw yield of rice were significantly influenced both by rice varieties and nitrogen sources. However, the interaction between varieties and nitrogen sources was non significant (Table 1). Among the varieties NLR - T 145 exhibited overall superiority to the three varieties. However, MTU 2067 and MTU 4870 were comparable. Nitrogen applied at 50% N through inorganic and 50% N through organic sources resulted in the highest grain yield, which was however, comparable to the combination of 75% N through inorganic and 25% N through organic source, but was distinctly superior to 100% N supply through fertilizer. Similar results were observed in case of Nitrogen uptake.

Grain quality characters *viz.*, head rice recovery, grain length and breadth, protein

Table 2 : Physical and Chemical quality characters of rice as influenced by varieties and nitrogen sources.

Treatments	Head Rice Recovery (%)	Grain Length (mm)	Grain Breadth (mm)	Protein Content (%)	Amylose Content (%)	Volume expansion ratio
Varieties						
V_1 : MTU 2067	61.25	5.920	2.624	7.35	19,36	3.00
V_1 : MTU 4870	63.75	5.831	2.634	7.52	20.21	2.97
V_1 : BPT 5204	68.00	6.931	2.220	7.87	20.83	3.18
V_1 : NLR - T - 145	63.35	6.030	2.642	7.67	20.32	3.17
C.D. (0.05)				0.3	0.7	NS
Nitrogen Sources						
N_0 : No nitrogen Application	61.00	5.812	2.441	7.10	18.18	2.52
N_1 : 50% nitrogen through fertilizer + 50% nitrogen through (FYM + green manure)	67.75	6.310	2.602	7.80	21.48	3.52
N_2 : 75% nitrogen through fertilizer + 25% nitrogen through (FYM + green manure)	65.25	6.210	2.592	7.70	20.75	3.42
N_3 : 100% nitrogen through fertilizer	63.00	6.023	2.491	7.30	20.31	2.86
SEm±	1.30	0.005	0.003	1.30	0.20	0.10
C.D. (0.05)	3.70	0.014	0.008	0.30	0.70	0.30
Interaction :						
Varieties X Nitrogen Sources	NS	NS	NS	NS	NS	NS

NS : Non significant

FYM : Farm yard manure

content, amylose content and volume expansion ratio were significantly influenced by rice varieties and nitrogen sources. However, the interaction between these two parameters exhibited non-significant values. Head rice recovery, length and breadth, protein content, and amylose content were significantly superior with the variety BPT 5204 but increase in volume expansion among the four varieties : BPT 5204, MTU 4870, MTU 2067, and NLR - Y - 145 was comparable. Significant improvement in the quality characters was due to the combination of 50% N through inorganic + 50% N through organic sources (FYM + GM) which was however comparable with the combination of 75% through fertilizer nitrogen and 25% through organics (FYM + GM), but displayed significant superiority over 100% N through fertilizer. Non-supply of N resulted in the lowest values of quality characters.(Table 2)

Rice crop enjoying comfortable N nutrition has resulted in better quality parameters. However most of the milling, nutritional and cooking quality characters are genotype dependent and hence would be altered only to a marginal extent by nutritional management. practices. Increase in head rice in the chaffy cultivars as a result of N application was due to an increase in the protein content of brown rice and a decrease in chaffy kernels. (Sakda Jongkaewwattana *et al.*, 1993). The nutritional status provided by these treatment combinations ensured the supply of nutrients to the crop, which inturn reflected on the increased amylose content of the grain. Higher protein content with integrated N nutrition is also encountered in the findings of Evans and Sarger. (1966), Bhuyan and Borah (1997), Swarup. (1995) and Dixit and Gupta. (2000).

The result of the present investigation clearly infers that quality characteristics of BPT 5204 manifested supremacy over the other three varieties. Under integrated N management practice of 50% N each through fertilizers and organic manure (FYM + GM) combination resulted in increased productivity and quality returns.

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Yield and Economics of Soybean as Influenced by Nitrogen and Phosphorus

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ABSTRACT

A field experiment was conducted for two consecutive years at Seed Production Farm, Gurazala to study the response of soyabean to nitrogen and phosphorus application. Grain yield increased significantly with increased nitrogen and phosphorus levels upto 40 and 60 kg ha^{-1}, respectively. Though the net ICBR was slightly higher under lower dose of nitrogen and phosphorus, the maximum incremental benefit over control was recorded with higher doses.

Key Words : Soybean, Nitrogen, Phosphorus, Economics.

Soyabean (*Glycine max* (L) Merrill) has been spreading fast, being the short duration crop having high protein content; and also fits suitably in different cropping systems. But the requirement of nitrogen and phosphorus is yet to be worked out for black cotton soils under Nagarjuna Sagar Project area where the availability of both the nutrients is low. Therefore, the present study was carried out to study the response of soybean to the applied nitrogen and phosphorus.

MATERIAL AND METHODS

A field experiment was conducted at Seed Production Farm, Gurazala during the *kharif* season of 1989 - 90 and 1990 - 91. The soil was sandy clay loam with pH 8.2, having low nitrogen (156 kg ha^{-1}), phosphorus (15 kg ha^{-1}) and high potash (267 kg ha^{-1}) contents. The experiment was laidout in a randomized block design based on factorial concept with four replications and three levels of each nitrogen (0, 20 and 40 kg ha^{-1}) and phosphorus (0,30 and 60 kg ha^{-1}). The total quantity of both nitrogen and phosphorus were applied at the time of sowing as per treatments. Urea and single superphosphate were used as sources of N and P_2O_5, respectively, during both the years. Hardee cultivar was sown on 10th July, 1989 and 12th July, 1990 at 30 x 10 cm spacing during the first and second year of experiment, respectively and the crop was harvested at physiological maturity.

RESULTS AND DISCUSSION

Yield and Yield Attributes

The pooled data of 1989-90 and 1990-91 revealed that the magnitude of increase in seed yield with 20 and 40 kg N ha^{-1} was 22.8 and 39.4 per cent, respectively compared with no nitrogen application (Table). Similar trend was observed in respect of yield contributing characters *viz.,* No. of branches, No. of pods plant^{-1} and 100 seed weight, which attributed positively to grain yield. This was in agreement with the reports of Paikera *et al.* (1988).

Table : Growth, yield attributes, yield and economics of soybean as influenced by nitrogen and phosphorus application during *kharif* (mean of 1989 - 90 and 1990 - 91)

Treatments	Plant height (cm.)	No. of branches/plant	No. of pods/ plant	100 seed weight (g)	Grain yield (q ha^{-1})	Addl. yield over control (q ha^{-1})	Incremental cost over control (Rs. ha^{-1})	Incremental benefit over control (Rs. ha^{-1})	Gross ICBR	Net ICBR
Nitrogen (kg ha^{-1})										
0	41.8	3.3	71	10.0	12.7	-	-	-	-	-
20	42.7	3.9	82	10.4	15.6	2.9	127	2900	22.8	21.8
40	43.3	4.1	85	10.6	17.7	5.0	254	5000	19.7	18.7
C.D (0,05)	NS	0.28	4.1	0.31	1.1	-	-	-	-	-
Phosphorus (kg ha^{-1})										
0	41.7	3.5	75	10.1	13.8	-	-	-	-	-
30	42.7	3.8	79	10.3	15.5	1.7	487	1700	3.5	2.5
60	43.4	4.0	84	10.5	16.7	2.9	975	2900	3.0	2.0
C.D (0.05)	NS	0.28	4.1	NS	1.1	-	-	-	-	-
NXP	NS	NS	NS	NS	NS					

Cost of Nitrogen nutrient -- Rs. 6.35 / kg
Cost of Phosphorus nutrient -- Rs. 16.25 / kg
Cost of Soybean seed -- Rs. 10.00 / kg

Application of 60 kg P_2O_5 ha^{-1} resulted in the highest grain yield (16.7 q ha^{-1}) and it was significantly superior over the lower levels of phosphorus. This might be due to increased number of branches and number of pods per plant at higher doses of phosphorus. Similar results were reported by Singh and Bajpai (1990).

Economics

Application of 40 kg N ha^{-1} recorded the maximum incremental benefit of Rs. 5000 ha^{-1} while recording an additional yield of 5 q ha^{-1} compared to control. However, the highest gross and net ICBR were observed with 20 kg N ha^{-1}. Similarly, the highest dose of phosphorus (60 kg ha^{-1}) though recorded the maximum incremental benefit over control by recording 2.9 quintal more grain yield, the gross and net ICBR were slightly better with lower doses of phosphorus.

Therefore application of 40 kg N and 60 kg P_2O_5 ha^{-1} is essential for achieving maximum grain yield and monetary benefits from soybean in black cotton soils of Nagarjuna Sagar Project area under rainfed condition, where the soil status of available nitrogen and phosphorus are low.

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Character Association and Path Analysis Studies for Quality Traits in Aromatic Rices

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ABSTRACT

The results of association and path analysis studies for seven important physicochemical quality characteristics revealed that kernel length after cooking was highly correlated with kernel length, length / breadth ratio and elongation ratio, and had a negative relationship with kernel breadth. Gelatinization temperature and amylose content were negatively related with each other.

Key Words : Path analysis, Kernel length, Elongation, Gelatinization.

In view of the diverse consumer preferences, breeding for grain quality forms an important objective in most rice breeding programs. Quality of rice is determined by a combination of many physico-chemical properties. Rice kernel size and shape are important quality components which directly influence the market value. Gelatinization temperature and amylose content are the principal determinants for cooking and eating qualities of milled rice. In addition, high kernel length after cooking and elongation ratio are the desirable quality traits especially in basmati types, which fetch high returns in domestic as well as in international markets. The study of association between different characters may help the plant breeder to know how the improvement of one character will bring simultaneous changes in other traits. Character association studies indicate the magnitude of variation between pairs of characters and are useful for selecting genotypes with desirable combination of characters. Though correlation gives information about the component traits, associated with other traits, they could not provide exact picture of relative importance of the direct and indirect contribution of the component characters. Thus, correlations in combination with path analysis would give a better insight into the cause and effect relationship between the different pairs of characters. Not many investigators have reported the association studies along with path coefficient analysis for important physico - chemical quality traits in rice. Therefore, an attempt was made in the present study to relate both correlation and path analysis results of six important quality traits (used as independent variables) on a dependent variable, the kernel length after cooking.

MATERIAL AND METHODS

Ten rice varieties/lines *viz.*, HBC 85, Karnal Local, Basmati 410, Basmati 6129, PGB, IR 6287 - 88 - 2 -1, PK 1379-9-1-1, Gaurav, IR 64 and PR 109 (the latter two varieties were non - scented) were crossed among themselves in a line x tester mating design to obtain 25 crosses. All these 35 genotypes were evaluated in a randomized block design with two replications at DRR farm, Hyderabad during *kharif* 1999. Single seedling per hill was planted with a spacing of 20 cm / 10 cm between and within the row, respectively and each entry consisted of 3 rows of 1.8 m length. Standard cultural practices and need based plant protection measures were undertaken to raise the crop. From each treatment, 10 randomly selected plants per replication were harvested and threshed separately. After six months of aging these seed samples were analysed on individual plant basis, for seven important physico - chemical quality traits *viz.*, kernel length (KL), kernel breadth (KB), length / breadth ratio (L/B ratio), kernel length after cooking (KLAC), elongation ratio (ER), alkali Spreading value (ASV) and amylose content (AC). Dehusking was done in a satake lab husker (THU 35 A) and polishing by using a small Kett polisher following standard procedures. Kernel length and kernel breadth were measured with Satake grain shape tester as indicated by Murthy and Govinda Swamy (1967). Length / breadth ratio was calculated as the ratio of mean kernel length to mean kernel breadth. Kernel length after cooking was determined by following the procedure described by Vergheese (1950). Elongation ratio was calculated as the ratio of mean cooked kernel length to mean uncooked kernel length. Alkali spreading value; an indirect measure of gelatinization temperature was estimated by following the method delineated by Little *et al.* (1958). Estimation of amylose content was done by following the simplified amylose procedure described by Juliano (1971). Correlation coefficients were computed on kernel length after cooking (dependent variable) for other quality traits by using the formulae suggested by Falconer (1964). The direct and indirect contribution of quality characteristics were calculated through path coefficient analysis as suggested by Wright (1921) and elaborated by Deway and Lu (1959).

RESULTS AND DISCUSSION

Kernel length after cooking (KLAC) had a significant positive association with kernel length, length / breadth ratio and elongation ratio while it showed negative relationship with kernel breadth both at genotypic and phenotypic levels (Table 1). Similar results were previously reported by Chauhan *et al.* (1987 and 1995), and Asha Christopher *et al.* (1999). Kernel length and L/B ratio manifested significant negative relationship with kernel breadth and a significant positive inter-relationship was observed between kernel length and length / breadth ratio. Moreover these two quality traits also exhibited positive direct effects on KLAC (Table 2). Hence it could be subtantiated that the simultaneous improvement of both kernel length and L/B ratio would result in increase in KLAC. Chauhan *et al.* (1995) and Asha Christopher *et al.*(1999) also reported positive inter-relationship between KL and L/B ratio. Elongation ratio had a non-significant negative association with KL while significant negative correlation was existed between ER and L/B ratio. These results are in agreement with the findings of Asha Christopher *et al.* (1999). ER exhibited a significant positive correlation with KLAC at both genotypic and phenotypic levels and manifested very high positive direct effect on KLAC suggesting that simple selection for ER would result in

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Table 1 : Correlation coefficients of seven quality traits in 25 hybrids and 10 parents

Character	Kernel length (mm)	Kernel breadth (mm)	Length/ breadth ratio	Elongation ratio	Gelatinization temperature	Amylose content (%)	Kernel length after cooking (mm)
Kernel length (mm)	1.000	-0.7479** -0.6852**	0.9086** 0.8572**	-0.2926 -0.3005	0.2155 0.1818	0.1221 0.1040	0.5281** 0.4844**
Kernel breadth (mm)		-	-0.9614** -0.9086**	0.3503 0.3117	0.0080 -0.0035	-0.1945 -0.1673	-0.2767 -0.2314
Length / breadth ratio				-0.3654* -0.3260*	0.1136 0.1071	0.1681 0.1396	0.3890* 0.3492*
Elongation ratio					-0.1532 -0.1254	-0.0387 -0.0274	0.6561** 0.6857**
Gelatinization temperature						-0.0466 -0.0460	0.0158 0.0092
Amylose Content (%)						-	0.0797 0.0696
Kernel length after cooking (mm)							1.0000

* : Significant at 5 % level

** : Significant at 1% level

underlined values are correlations at Genotypic level

Table 2 : Path coefficients of various quality traits for hybrids and parents

Character	Kernel length (mm)	Kernel breadth (mm)	Length/ breadth ratio	Elongation ratio	Gelatinization temperature	Amylose content (%)
Kernel length (mm)	0.7531 0.7729	-0.702 -0.0061	0.1066 -0.0076	-0.2585 -0.2737	-0.0053 -0.0028	0.0024 0.0017
Kernel breadth (mm)	-0.5633 -0.5296	0.0938 0.0089	-0.1128 0.0081	0.3095 0.2839	-0.0002 0.0001	-0.0038 -0.0027
Length / breadth ratio	0.6842 0.6625	-0.0902 -0.0081	0.1173 -0.0089	-0.3228 -0.2969	-0.0028 -0.0016	0.0032 0.0022
Elongation ratio	-0.2204 -0.2322	0.0329 0.0028	-0.0429 0.0029	0.8834 0.9108	0.0037 0.0019	-0.0007 -0.0004
Gelatinization temperature	0.1623 0.1405	0.0007 -0.0010	0.0133 -0.0010	-0.1353 -0.0153	-0.0244 -0.0153	-0.0009 -0.0007
Amylose Content (%)	0.0920 0.0804	-0.0182 -0.0015	0.0197 -0.0012	-0.0342 0.0007	-0.0011 0.0007	0.0193 0.0161

Underlined values are direct effects and all others are indirect effects on kernel length after cooking

Values in italics are path coefficients at genotypic level.

improvement of KLAC. Alkali spreading value and amylose content had a negligible correlation with KLAC, moreover they also exhibited poor direct effects. According to Chauhan *et al.* (1995) ASV and amylose content were independent of KLAC which also is in accordance with the results of present investigation. However these two traits were negatively inter-relatied with each other at both levels and alkali values also manifested negative indirect effects via amylose content on kernel length after cooking. Earlier Juliano and Pascual (1980), Chauhan *et al.* (1995) and Juliano and Gonzales (1989) also observed same relationship between ASV and AC. Finally based on the above results it could be concluded that kernel length, length/breadth ratio and elongation ratio manifested positive and significant relationship with KLAC while kernel breadth exhibited negative association. Kernel length, length/breadth ratio and elongation ratio also had high positive direct effect on kernel length after cooking. Hence selection for these quality traits would effectively increase the kernel length after cooking in breeding programmes tailored to transfer this typical trait of basmati into semi - dwarf background.

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Genetic Variability, Heritability And Genetic Advance In Scented Rice

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ABSTRACT

Genetic variability, heritability and genetic advance were studied in 200 scented rice genotypes including one non-scented check, Ratna for grain yield and its nine attributing characters. High GCV and PCV values were obtained for panicle number, number of spikelets / panicle, number of grains/panicle and grain yield / plant. High heritability along with high genetic advance were observed for number of spikelets / panicle, number of grains/panicle, grain yield/plant followed by other characters. Emphasis should be given on these characters while selecting sceented rice varieties to improve grain yield.

Key Words : Scented rice, genetic variability, heritability, genetic advance.

The scented rice has high premium value in national as well as in international market due to unique aroma and quality. But they are generally poor yielders and photosensitive, so there is a need to develop photoinsensitive varieties with good grain yield. High level of genotypic and phenotypic variability is essential for selection of desirable genotypes in any crop improvement programme. Moreover, the heritability values along with genetic advance were more useful than the heritability estimates alone while selection. Hence, the present study was undertaken to estimate different genetic parameters in scented rice.

MATERIAL AND METHODS

The present experiment consisted of 200 scented rice genotypes including one non-scented check Ratna and were grown at Central Rice Research Institute, Cuttack. One-month-old seedlings were transplanted in randomised block design with three replications. Observations were recorded on five plants selected at random from each replication for grain yield/plant and its nine attributing characters *viz.,* days to 50% flowering, plant height, panicle number/plant, panicle length, number of spikelets/panicle, number of grains/panicle, 1000-grain weight, grain length, and length / breadth ratio. The GCV, PCV, heritability and genetic advance were calculated by following the method suggested by Johnson *et al.* (1955).

RESULTS AND DISCUSSION

The analysis of variance for grain yield and its components indicated significant

Table : Variability parameters in scented rice

Character	Range	Mean	GCV	PCV	Heritability	GA in % of mean
Days to 50% flowering	74.33-140.67	110.63	9.94	9.96	99.5	20.43
Plant height (cm)	69.67-156.00	123.27	11.92	12.23	95.1	23.95
Panicle number / plant	2.33-9.33	5.37	25.54	30.23	71.4	44.51
Panicle length (cm)	17.20-30.11	23.94	10.63	11.68	82.9	19.92
Number of spikelets / panicle	31.67-223.67	92.94	39.07	39.53	97.7	79.56
Number of grains / panicle	15.24-187.67	65.25	47.75	48.26	97.9	97.33
1000-grain weight (g)	12.35-29.99	19.12	17.69	18.07	95.9	35.67
Grain length (mm)	6.20-11.29	9.09	15.61	15.65	99.4	32.01
Length / Breadth ratio	3.02-6.04	4.90	14.79	15.08	96.2	30.00
Grain yield/plant (g)	1.50-17.17	6.39	48.00	50.57	90.1	93.90

differences among the genotypes for all the characters studied. The expression of quantitative character is very much influenced by environment and this forms a part of genetic variation that are inherent to genotype. The estimates of genetic parameters (Table) revealed very low magnitude of difference between GCV and PCV for most of the characters studied indicating little environmental influence. In the present study GCV and PCV values were high for panicle number, number of filled grains/ panicle, number of spikelets/panicle and grain yield/plant. Similar findings on genetic variability on different characters have also been reported by Saravanan and Senthil (1997). Medium to low values of GCV and PCV were observed for plant height, panicle length, 1000-grain weight, grain length, length/breadth ratio and days to 50% flowering which was supported by Maurya *et al.* (1986) and Saravanan and Senthil (1997). Low values of GCV and PCV were observed for days to 50% flowering by Chauhan *et al.* (1993). This low variability may be due to the presence of both positive and negative alleles for this character.

Heritability estimates were high for all the characters studied. The heritability values ranged from 71.4% (panicle number/plant) to 99.5% (days to 50% flowering). Maurya *et al.* (1986), Nath and Talukdar (1997) also confirmed the above findings.

The genetic advance expressed in percentage of mean was high for number of grains/panicle, number of spikelets/panicle and grain yield / plant followed by other characters. So the observation of high heritability along with high genetic advance for almost all the characters studied indicated the importance of additive gene action in the inheritance of these characters (Johnson *et al.*, 1955; Sharma *et al.*, 1998). In the present study, most of the characters are controlled by additive gene action. Mass selection procedure can be used to improve grain yield (Ramlingam *et al.,* 1994). Hence, for yield improvement all the contributing characters except panicle length would have the scope for selection.

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Decontamination of Lindane, Chlorpyrifos and Quinalphos from Soil by Different Physical Methods

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ABSTRACT

A pot culture experment was conducted taking cowpea as the test crop. The pesticides, lindane, chlorpyrifos and qinalphos were applied to the soil at recommended doses of 1.0, 0.5 and 0.5 kg a.i. ha^{-1}, respectively. Some of the physical methods like covering the soil with paddy straw and polythene were adopted for decontamination of the pesticides. The soil samples were collected at 0,5,10,20 and 30 days after application of the toxicant and residues of the pesticides were estimated by Gas Liquid Chromatograph (GLC). There was positive response of decontamination of pesticides by the above mentioned physical methods when compared with untreated soil. The paddy straw mulching resulted in better decontamination than the polythene cover.

Key Words : Decontamination, Chromatograph, Organochlorine, Organophosphorus.

Lindane is a strong contact and stomach poison with fumigant properties. Chlorpyrifos is a strong contact and stomach poison with vapour action and also effective against pests. Quinalphos is a strong contact and stomach poison and effective against wide spectrum of insect pests. Nerin *et al.* (1996) studied the absorption of some organochlorine and organophosphorus pesticides on low density polyethylene (LDPE) films used as agricultural soil cover. Most of the pesticides studied were completely absorbed on the plastic films after 15 days of contact time.

Cisar and Snyder (1996) studied the mobility and persistence of chlorpyrifos applied to a USGA cv green. The quantity of each organophosphate pesticide in turf clippings, thatch, soil and percolate was determined over two application cycles. Most of the applied O.P. pesticides appeared to be retained in the thatch layer, where presumably they, were microbially degraded over time.

MATERIAL AND METHODS

The pot culture experiment was conducted with the surface soil (Oxic Haplustult) collected from the central farm, O.U.A.T., Bhubaneswar, Orissa. The soil has 64.4% sand, 14% silt, 21.6% clay representing sandy loam texture with pH 4.29, EC 0.128 dSm^{-1}, OC 0.65%, CEC 3.6 cmol(P^{+})kg^{-1}, available N, P_2O_5, K_2O were 92, 20.4 and 112.8 kg ha^{-1}. Ten kg of the processed soil was taken in the porcelein pot and four seeds of cowpea (Var. SEB-2) were sown in each pot. The insecticides lindane (20EC), chlorpyrifos (20EC) and quinalphos (25EC) were applied at the rate of 1.0, 0.5 and 0.5 kg a.i.ha^{-1}, respectively to the soil at the time of flowering of the crop. The straw and polythene covering was provided in the respective pots. The soil samples were collected from the control and treated pots at

0,5,10 and 20 days after treatment of the toxicant along with the harvested sample. The residues of lindane, chlorpyrifos and quinalphos were estimated both from soil and plant samples by the GLC (chemito) 8610 HT - ECD adopting the standard procedures.

RESULTS AND DISCUSSION

It was observed (Table 5) that lindane treated soil alone, soil covered with black polythene and soil treated with rice straw contained 0.325, 0.258 and 0.182 ppm residues of lindane on 'O' day after treatment of the toxicant and it reduced to 0.087. 0.052 and 0.031 ppm at the time of harvest in soil alone, soil with polythene and soil with straw, respectively. The percentage of degradation was increased from 23.38 to 73.23, 28.68 to 79.84 and 32.96 to 82.96 in control, soil with black polythene and straw mulch, respectively. The half-lives (RL_{50}) were found to be 16.91, 13.80 and 12.28 days in control, black polythene and straw mulch soils.

It was observed (Table 6) that chlorpyrifos treated soil alone, soil covered with black polythene and soil with straw mulch contained 0.783, 0.697 and 0.562 ppm residues of chlorpyrifos on 'O' day which degraded to 0.125, 0.087 and 0.061ppm at 20 days and non detectable level at the time of harvest, respectively. The percentage of degradation increased from 37.16 to 100, 40.02 to 100 and 43.41 to 100 in control, soil with black polythene and soil with straw mulch, respectively. The half-lives were found to be 7.48, 6.60 and 6.13 days in each case. Similar results were also observed by Racke *et al.* (1993).

Table 7 revealed that quinalphos treated soil, soil covered with black polythene and mulched with straw contained 0.617, 0.530 and 0.408 ppm residues on 'O' day which reduced to 0.117, 0.089 and 0.051 ppm residues of quinalphos at 20 days and non detectable level at the time of harvest (30 days), respectively. The percentage of degradation increased from 28.52 to 100, 33.02 to 100 and 41.17 to 100 with half-lives (RL_{50}) of 8.22, 7.68 and 6.58 days in control, soil with black polythene and soil with straw mulch, respectively.

It can be concluded that organochlorine pesticides like lindane can be retained more than the organophosphorous pesticides like chlorpyrifos and quinalphos. Similarly the rate of degradation is more in case of organophosphorous than organochlorine groups of pesticides. The polythene cover and straw mulch helped in degradation and thus decontamination of pesticides like, lindane, chlorpyrifos and quinalphos. Both the treatments gave higher values than the control and straw mulching is more efficient than polythene cover. Similar results were also observed by Whang *et al.* (1993).

Table 1 : Physico - chemical properties of soil

1.	Mechanical composition		
	Sand (%)	-	64.4
	Silt (%)	-	14.0
	Clay (%)	-	21.6
	Textural class	-	Sandy loam
2.	pH	-	4.29
3.	EC(dS m^{-1})	-	0.128
4.	OC (%)	-	0.657
5.	CEC (c mol (P+)kg^{-1})	-	3.6
6.	Available nitrogen (N) kg ha^{-1}	-	92
7.	Available phosphorous (P_2O_5)kg ha^{-1}	-	20.40
8.	Available potassium (K_2O) kg ha^{-1}	-	112.8

Table 2 : Meteorological data of Bhubaneswar from January 1998 to August 1998.

Month	Temp. im °C			Rain fall		Relative humidity %			Sunshine hour
	Maximum	Minimum	Mean	in mm	No.of rainydays	Morning	Afternoon	Mean	
January	28.8	16.5	22.6	26.4	2	90	52	71	7.5
February	31.0	19.0	25.0	20.9	5	93	52	73	7.7
March	33.5	22.1	27.	67.3	8	94	55	74	8.0
April	36.2	24.4	33.3	77.8	5	92	53	73	8.8
May	38.8	27.1	33.0	40.5	5	86	49	68	8.9
June	36.8	27.2	32.0	164.4	12	90	61	76	4.6
July	32.9	25.5	29.2	341.5	20	93	77	85	4.6
August	32.6	25.9	29.2	163.5	17	94	80	87	4.1

Table 3 : Standards of lindane, chlorpyrifos and quinalphos

Toxicant	Standard solution in ppm	Retention time in minute	Peak height in cm
Lindane	1	0.57	13.0
Chlorpyrifos	1	2.0	2.5
Quinalphos	10	2.54	8.1

Table 4 : Recoveries of lindane, chlorpyrifos and quinalphos

Toxicant	ppm fortified	ppm recovered	Recovery %
	Soil		
Lindane	1	0.89	89
	2	1.806	90.3
Chlorpyrifos	1	0.87	87
	2	1.728	86.4
Quinalphos	1	0.867	86.7
	2	1.702	85.1
	Plant		
Lindane	1	0.798	79.8
	2	1.604	80.2
Chlorpyrifos	1	0.771	77.1
	2	1.516	75.8
Quinalphos	1	0.734	73.4
	2	1.506	75.3

Table 5 : Effect of black polythene and straw mulch on decontamination of Lindane from soil

Days after treatment (DAT)	Control soil		Soil treated with black polythene		Soil treated with straw mulch	
	Residues in ppm	% loss	Residues in ppm	% loss	Residues in ppm	% loss
0	0.325	0	0.258	0	0.182	0
5	0.249	23.38	0.184	28.68	0.122	32.96
10	0.196	39.69	0.149	42.24	0.094	48.35
20	0.153	52.92	0.101	60.85	0.060	67.03
30 (harvest)	0.087	73.23	0.052	79.84	0.031	82.96
	Y = 2.8574 - 0.0178 X RL_{50} = 16.91 days		Y = 2.3954 - 0.0218 X RL_{50} = 13.80 days		Y = 2.2365 - 0.0245 X RL_{50} = 12.28 days	

Table 6 : Effect of black polythene and straw mulch on decontamination of Chlorpyrifos from soil

Days after treatment (DAT)	Control soil		Soil treated with black polythene		Soil treated with straw mulch	
	Residues in ppm	% loss	Residues in ppm	% loss	Residues in ppm	% loss
0	0.783	0	0.697	0	0.562	0
5	0.492	37.16	0.418	40.02	0.318	43.41
10	0.273	65.13	0.199	71.44	0.134	76.15
20	0.125	84.03	0.087	87.51	0.061	89.14
30 (harvest)	N.D.	100	N.D.	100	N.D.	100
	Y = 2.8792 - 0.0402 X RL_{50} = 7.48 days		Y = 2.8215 - 0.0456 X RL_{50} = 6.60 days		Y = 2.7171 - 0.0491 X RL_{50} = 6.13 days	

Table 7 : Effect of black polythene and straw mulch on decontamination of Quinalphos from soil

Days after treatment (DAT)	Control soil		Soil treated with black polythene		Soil treated with straw mulch	
	Residues in ppm	% loss	Residues in ppm	% loss	Residues in ppm	% loss
0	0.617	0	0.530	0	0.408	0
5	0.441	28.52	0.355	33.02	0.240	41.17
10	0.252	59.15	0.192	63.77	0.126	69.11
20	0.117	81.03	0.089	83.20	0.051	87.50
30 (harvest)	N.D.	100	N.D.	100	N.D.	100
	Y = 2.7952 - 0.0366 X RL_{50} = 8.22 days		Y = 2.718 - 0.0392 X RL_{50} = 7.68 days		Y = 2.5973 - 0.0457 X RL_{50} = 6.58 days	

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Minimisation of Adverse Effects of Residual Sodium Carbonate (RSC) Waters with Use of Amendments on Rice Yields

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ABSTRACT

An experiment was conducted during 2000 and 2001 at farmers field, Vippaguntla village, Prakasam district using gypsum, FYM and green manures and their combination to reduce ill effect of RSC waters on crop (rice) yields. Results indicated nearly 50% yield increase when treated with 2.5 t ha^{-1} of gypsum + 2.5 t ha^{-1} of green manures than that of control (no amendments). The concentration and uptake of nutrients by rice also increased with use of the amendments besides, a reduction in soil pH, EC and increase in available N and P_2O_5 contents after the harvest of crop even after crop removal.

Key Words : Adverse, Residual Sodium Carbonate, Amendments.

A systematic ground water survey carried out in various districts of Andhra Pradesh indicated presence of high Residual Sodium Carbonate (RSC) water in Anantapur, Prakasam, Nellore and Mahaboobnagar districts. The crop yields were adversely affected due to use of these waters. Negative effects on crop yields were reported by Sharma and Minhas (1996) due to use of high RSC waters and soil properties also deteriorated (CSSRI, 2000). Hence, an experiment was taken up on farmer's field, at Vippaguntla (Prakasam district) in collaboration with DAATT Centre of the district to study the effect of various amendments *viz.*, gypsum, FYM and green manures on minimization of adverse effect of RSC waters on the performance of paddy crop.

MATERIAL AND METHODS

Field trials were initiated in late *kharif* 2000 and 2001 on farmer's field, at Vippaguntla village, Prakasam district. The soil had a pH of 8.5 and 8.2 in surface and sub-surface, respectively. The irrigation water showed RSC content of 8.2 me l^{-1} (Table 1). Seven treatments were adopted in this study (Table 2) each replicated thrice in a simple randomized block design. Gypsum was applied before the final puddling operation. FYM and green manure were applied 10 days before transplantation to enable proper decomposition. Neem leaves and twigs were used as green manures. Rice variety NLR - 33641 was grown. Plant and soil samples were collected at harvest stage of the crop. Standard procedures were adopted for the estimation of N,P,K and Na in these samples.

RESULTS AND DISCUSSION

Yields

The highest grain yield of 5481.7 kg ha^{-1} were obtained during 2000 by the treatment T_7, which received green manures and gypsum each @ 2.5 t ha^{-1}. The treatment T_6 (which received green manures @ 5 t ha^{-1}) was also on par with the best treatment of T_7, which recorded

Table 1 : Initial analysis of water and soil

S.No.	pH	EC (dSm^{-1})	m.eq/l								SAR
			$CO_3^=$	HCO_3^-	Cl^-	$SO_4^=$	Ca^{++}	Mg^{++}	Na^+	RSC	
Water											
2000	8.80	1.93	3.4	8.80	4.02	2.23	1.8	1.6	16.52	9.2	13.78
2001	8.12	2.10	1.2	13.60	12.0	6.34	2.0	3.2	33.70	9.6	14.71
Soil (Saturated extract) Initial											
0 -15 cm	8.5	3.23	3.4	1.2	7.2	1.62	4.4	1.2	28.69	-	15.8
15 -30 cm	8.2	2.71	-	3.6	19.2	6.42	4.4	0.3	24.78	-	14.84

5456.7 kg ha^{-1} followed by treatments T_3, T_4 and T_5, which were all on par with each other. The lowest yield of 3000 kg ha^{-1} was observed in control (the treatment to which no amendment was added) (Table 1 and Fig.1). During the second year of experimentation (2001) the trends observed during the previous year were repeated. The yields of grain recorded by T_4, T_5, T_6 and T_7 were all on par with each other proving that application of gypsum along with FYM or green manure is an ideal combination in minimizing the ill effects of RSC waters on crop yields.

The highest straw yields too were observed in T_7 during both the years, recording 7880 kg ha^{-1} and 6843.7 kg ha^{-1} during 2000 and 2001, respectively. It is interesting to observe that there was more than 2 tonne yield difference in straw / grain between T_1 and T_7 during both the years of study. Such positive effects of addition of gypsum and FYM / green manure on yield of rice and wheat on an alkali soils was reported by Yaduvanshi (1998 and 2001). Sharma *et al.* (2001) also reported crop yield increments of 3 to 12% and 5 to 8% in sustainability index when 1.25 t ha^{-1} gypsum was applied in an experiment using RSC (10 meq/l) water. Such yield increments due to the use of gypsum were also reported in pearl millet (Anonymous, 2000). However, the results obtained were not in conformity with those obtained by Swarup (1997) who reported no effect of amendments on rice yields.

Uptake of nutrients

The trends observed in dry matter yields and concentrations of nutrients were reflected in the uptake of N,P, K and Na of grain and straw. The highest uptake of N,P and K during both the years of experimentation was by T_7, the treatment which has put up the highest yields of grain and straw, besides showing the highest N,P and K concentration. The N uptake in T_7 (67.97 kg ha^{-1}) was found to be on par with that of T_6 (67.47 kg ha^{-1}) indicating that application of 2.5 t ha^{-1} of gypsum+green manure @ 2.5 t ha^{-1} or green manure alone @ 5 t ha^{-1} had similar effect in this regard (Table 3).

The treatments T_6 and T_7 were on par with each other with regards to P uptake by grain during both the years. In straw, on the contrary, T_3 (7.56 kg ha^{-1}) and T_7 (7.98 kg ha^{-1}) were on par during the first year of study while during the second year T_2 to T_7 were all on par with each other. There was an almost 100% increase in P uptake between T_1 and T_7 by both grain and straw. The highest K uptake was by T_7 (17.36 and 15.57 kg ha^{-1} during 2000 and 2001). The lowest values of N,P,K and Na uptake were observed by T_1 (32.29, 8.63, 8.43 and

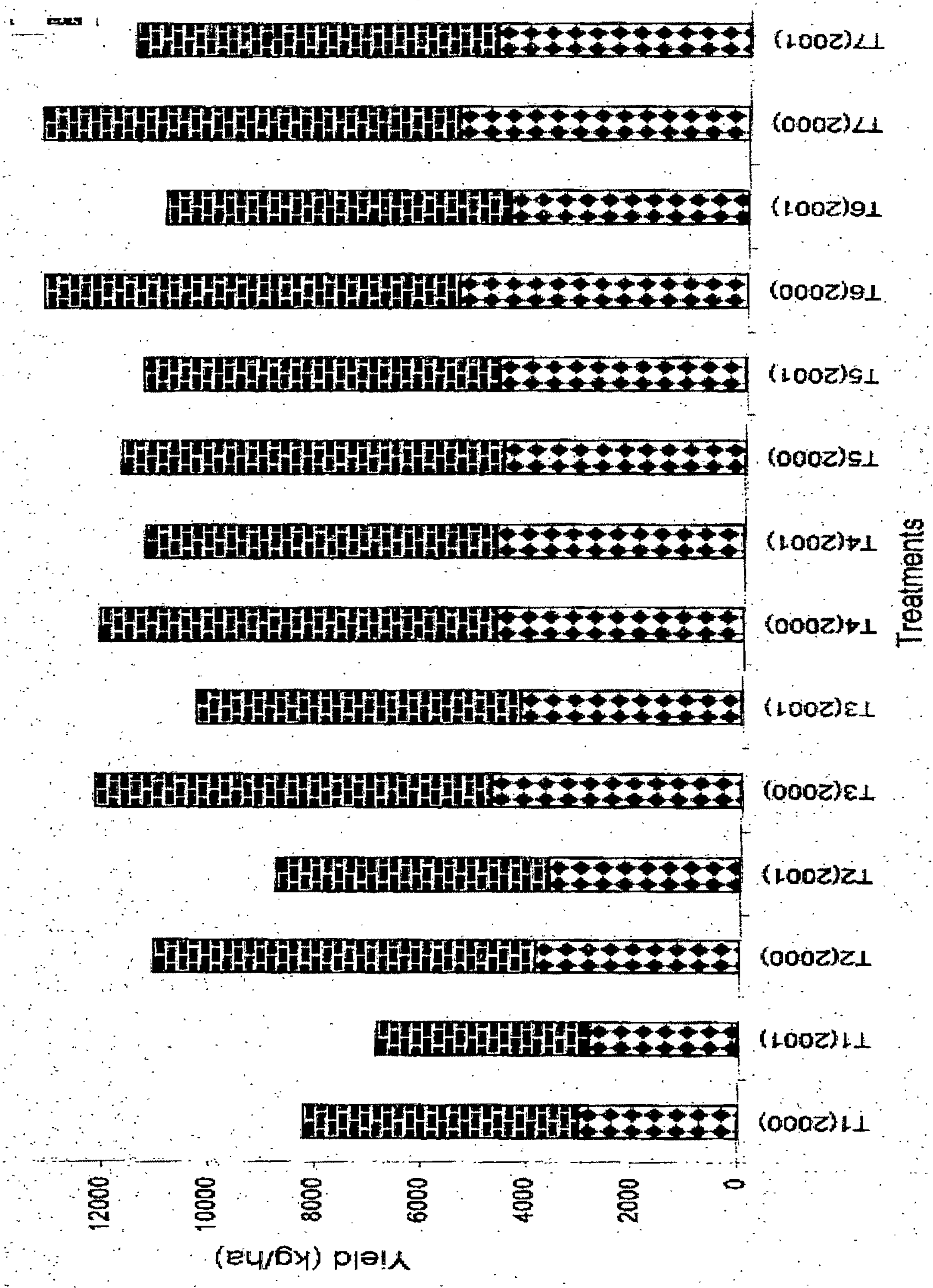

Fig. 1: Effect of different amendments on mitigating adverse effect of RSC waters on yields of paddy

Table 2 : Effect of different amendments on mitigating the adverse effect of RSC waters on grain and straw yields of rice crop

Treatments	Yield (kg ha^{-1})			
	Grain		Straw	
	2000	2001	2000	2001
T_1 Control i.e. Well water without any amendment	3000.0	2812.3	5211.0	4032.0
T_2 Gypsum Application to soil @ 5 t ha^{-1}	3866.7	3625.0	7208.3	5164.3
T_3 FYM @ 10 t ha^{-1}	4725.0	4188.0	7481.7	6161.0
T_4 Gypsum 50% + 50% FYM (2.5 t ha^{-1} Gypsum + 5 t ha^{-1} FYM)	4675.0	4688.0	7485.0	6637.0
T_5 passing of gypsum through irrigation water (@ 1/2 bag per irrigation)	4575.0	4675.0	7223.3	6732.0
T_6 Green manure @ 5 t ha^{-1}	5456.7	4500.0	7826.7	6512.3
T_7 Green manure @ 2.5 t ha^{-1} + Gypsum @ 2.5 t ha^{-1}	5481.7	4775.0	7880.0	6843.7
Mean	4540.0	4180.5	7188.0	6011.8
S.Em (±)	94.078	140.99	48.583	218.75
C.D (0.05)	204.996	307.216	105.863	476.65
C.V %	2.540	4.13	0.83	4.46

Note : During the year 2001, rice crop was planted late due to delayed monsoon.

Table 4 : Effect of different amendments on mitigating the adverse effect of RSC waters on soil pH, ECe, available N,P,K and Na at harvest of paddy (2000 - 2001)

Treatment	pH		ECe dSm^{-1}		N (kg ha^{-1})		P_2O_5 (kg ha^{-1})		K_2O (kg ha^{-1})		Na (kg ha^{-1})	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
T_1	8.72	8.71	0.85	2.51	169.84	163.77	14.93	14.63	469.33	427.87	2319.67	2377.67
T_2	8.72	8.40	0.87	1.68	176.73	182.47	15.32	16.13	463.67	415.43	1922.67	1883.33
T_3	8.73	8.25	0.84	1.59	188.97	189.03	14.47	16.13	477.67	404.39	1894.67	1895.33
T_4	8.73	8.37	0.84	1.23	184.06	191.61	14.87	15.88	500.00	429.12	1922.67	1906.67
T_5	8.73	8.37	0.86	1.75	183.03	195.61	14.08	15.90	468.00	418.15	1948.67	1927.33
T_6	8.72	8.21	0.83	1.45	186.39	198.35	14.43	15.91	459.33	422.31	1940.67	1905.33
T_7	8.71	8.45	0.84	1.47	194.00	202.93	14.10	16.19	458:67	420.11	1918.67	1892.67
Mean	8.73	8.39	0.848	1.67	183.29	189.11	14.60	15.82	470.95	419.63	1981.10	1969.76
S.Em				0.175	8.991	4.909	0.497		15.850	6.581	46.390	24.201
C.D	NS	NS	NS	0.382	19.591	10.697	1.084	NS	34.537	14.339	101.083	52.734
C.V at (5%)	0.87	2.02	8.480	8.05	6.010	3.18	4.170	3.47	4.20	3.95	2.870	1.5

2.79 kg ha^{-1} by grain and 29.76, 4.03, 51.6 and 28.36 kg ha^{-1} by straw, respectively (mean of two years). There was 50% increase in uptake of N and P by grain between T_1 (no amendments) and T_7 (2.5 t ha^{-1} gypsum + 2.5 t ha^{-1} green manure).

The lowest Na uptake was observed by T_1 in both grain and straw during the two years of experimentation. However, during the second year, the highest Na uptake was recorded by treatments from T_4 to T_7. Invariably the lowest

Table 3 : Effect of different amendments on mitigating adverse effect of RSC waters on uptake of N,P,K and Na in grain and straw of rice.

Treatments	Grain								Straw							
	N		P		K		Na		N		P		K		Na	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
T_1	33.77	30.81	9.00	8.25	8.80	8.05	2.70	2.87	33.72	25.79	4.45	3.60	56.31	46.93	31.98	24.74
T_2	46.77	45.86	12.64	10.96	11.95	11.22	3.04	3.71	51.18	35.58	7.02	5.28	82.17	63.56	37.97	29.03
T_3	55.63	49.31	15.44	13.10	15.15	13.18	4.10	4.05	50.14	41.43	7.56	6.23	88.80	81.24	37.90	32.54
T_4	57.74	60.61	15.25	14.92	15.47	15.20	4.25	4.47	50.90	46.14	7.29	7.09	85.35	81.90	39.43	36.25
T_5	49.42	57.50	14.03	14.77	13.72	15.06	4.70	4.70	50.11	46.69	7.17	6.38	84.71	90.96	39.51	36.69
T_6	67.47	58.78	18.69	14.49	16.94	14.59	5.06	4.44	53.22	46.00	6.73	6.67	92.36	89.92	41.21	34.55
T_7	67.97	62.81	18.99	15.47	17.36	15.57	5.59	4.65	55.16	48.09	7.98	6.94	94.08	92.60	40.45	35.68
Mean	54.11	51.36	14.86	13.14	14.20	13.27	4.21	4.13	49.20	41.39	6.89	6.03	83.40	78.16	38.35	32.78
S.Em	2.44	2.497	1.08	0.661	1.28	0.649	0.42	0.181	1.80	1.382	0.26	0.423	3.94	4.217	2.47	1.618
C.D	5.31	5.441	2.35	1.44	2.78	1.413	0.92	0.394	3.91	3.011	0.56	0.923	8.58	9.188	5.39	3.525
C.V at(5%)	5.52	5.85	8.90	6.16	11.01	5.99	12.29	5.37	4.47	4.09	4.58	8.6	5.78	6.61	7.90	6.04

uptake values of N, P, K and Na were observed by T_1, the treatment to which no amendment was added and better uptake values were observed by other treatments (T_2 - T_7), thus proving the reduction of ill effects of RSC waters due to use of amendments.

Soil parameters

There was a significant effect of different amendments used to mitigate the ill effects of RSC waters on soil pH (Table 4). It varied from 8.71(T_7) to 8.33 (T_3, T_4 and T_5) but nonsignificant. Low soil pH was reported in plot amended with gypsum and FYM (Yaduvanshi, 1998 and 2001; Swarup, 1997). Electrical conductivity though remained unaffected during the first year of study, showed variations with treatments during the second year. There was a drastic raise in EC during second year as indicated by yearly means of 0.85 dSm^{-1} (2000) and 1.67 dSm^{-1} (2001), respectively. Sharma and Minhas, 1997 also reported reduction in soil EC due to use of gypsum as amendment. The available nitrogen at harvest of crop increased at the end of each year in all treatments over that of T_1. However, the highest increase in N was observed by T_7 (194 kg ha^{-1} at the end of first year and 202.93 kg ha^{-1} at the end of second year). The highest soil available P_2O_5 at the time of harvest of crop during the first year was observed by T_2, however, this was on par with that of T_1, T_3, T_4 and T_6. During second year no significant effect was observed.

There was a drastic reduction in status of available K_2O content at harvest of crop during second year. The mean values of K_2O at the end of first year was 470.95 kg ha^{-1} and reduced to 419.67 kg ha^{-1} during second year, thus indicating that crop requirement has increased tremendously during second year. The soil status of available Na increased from 2319.60 to 2377.67 kg ha^{-1} during harvest in first and second years, respectively. This indicates that continuous use of RSC water without amendments deteriorates soil health. However, in all other treatments that received amendments in the form of either gypsum / FYM / green manure / combination of these recorded lower available Na rates in soil than control. This proves that use of amendments mitigates the ill effect of RSC especially that of Na. Swarup (1997) reported positive effects of gypsum and FYM on soil properties in rice - wheat rotation with continuous sodic water usage for irrigation.

Conclusions

Use of various amendments *Viz.*, gypsum, FYM and green manure to mitigate the ill effect of RSC water on performance of rice crop showed favourable results. There was almost 50% grain yield increment by the application of gypsum @ 2.5 t.ha^{-1} + green manure @ 2.5 t.ha^{-1} over that of T_1 (the treatment to which no amendment was added). The straw yield too increased in treatments receiving amendments over that of T_1 though highest was observed by T_7 (gypsum 2.5 t.ha^{-1} + green manure 2.5 t.ha^{-1}). Besides spectacular yield improvements there was an increase in nutrient concentration and uptake of N,P and K in both grain and straw due to use of amendments. Application of gypsum @ 2.5 t.ha^{-1} and green manure @ 2.5 t.ha^{-1} proved to be the best performer among all other treatments in minimizing the adverse effect of RSC waters on rice crop. The soil properties too improved due to the addition of amendments.

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Effect of Conjunctive use of Nitrogen Sources on Seed Yield, Soil Physico - Chemical Properties and Available Macronutrient Status in Sunflower

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ABSTRACT

A field experiment wsa conducted on sandy loam soil during *rabi* 2000 - 2001 at Rajendranagar, Hyderabad to investigate the effect of vermicompost, farm yard manure and *Azospirillum* inoculation with seed alone and in conjunction with urea on yield, soil physico-chemical properties and available macronutrient (N, P and K) status at the harvest of sunflower crop. The results revealed that application of 50% recommended dose of nitrogen (RDNF) through vermicompost + 50 % RDNF through inorganic fertilizer recorded the highest seed yield. EC and pH at harvest of the crop were not significantly influenced by various treatments. Vermicompost (VC) application resulted in the highest increase of inorganic carbon and availble macronutrient starus (N,P and K) followed by farm yard manure application. Among the VC treatments, 100% RDNF through VC, 75% RDNF through VC + 25% RDNF through urea and 50% RDNF through VC + 50% RDNF through urea were equally effective in increasing organic carbon and available macronutrient (N,P and K) status of soil as compared to other treatments.

Key Words : Conjunctive, Soil Physico - Chemical Properties, Macronutrient, N,P,K, Vermicompost.

The advent of high yielding varieties and increased area under assured irrigation led to a major shift from organic based nutrient application to chemical fertilizers. Consequently, there was not only a reduction in the consumption of organic manures but also excess use of high analysis fertilizer in an unbalanced manner and imposed additional problems of soli fertility, such as : acidity, alkalinity, multiple nutrient deficiencies and loss of soil health. In view of the escalating prices and high demand supply gap of chemical fertilizer, there is a strong need to adopt integrated nutrient supply system by judicious combination of organic manures, bio-fertilizers and inorganic fertilizers to improve soil health and productivity. Hence, the present study was undertaken to know the response of vermicompost, farm yard manure, *Azospirillum* alone and in conjunction with inorganic nitrogen on yield, soil physico-chemical properties and available macronutrient status at harvest of sunflower crop.

MATERIAL AND METHODS

A field experiment was conducted during *rabi* 2000 - 2001 with sunflower (Morden) under irrigated conditions on sandy loam soil at Rajendranagar, Hyderabad. The initial properties of the experiment site were pH 7.6, EC 0.16 dSm^{-1}, organic carbon 0.45%, available N, P_2O_5, and K_2O 206.32, 33.4 and 286.93 kg ha^{-1}, respectively. The fourteen treatments consisted of 25, 50, 75 and 100 per cent recommended dose of nitrogen (RDNF) @ 60 kg N ha^{-1} each of vermicompost and farm yard manure and seed inoculation with *Azospirillum* alone and in combination with 25, 50 and 75 per cent RDNF through urea along with control (0

Table 1 : Effect of conjunctive use of nitrogen sources on seed yield, soil physico - chemical properties and available macro nutrient status at harvest of the sunflower crop

	Treatment	Seed yield (q ha^{-1})	pH	EC (dS m^{-1})	OC (%)	N	P_2O_5	K_2O
						kg ha^{-1}		
T_1	Control	6.38	7.6	0.16	0.46	183.62	32.30	276.18
T_2	100% RDNF through urea	9.56	7.6	0.16	0.49	218.32	38.64	295.19
T_3	100% RDNF through VC	8.55	7.8	0.15	0.59	245.13	50.30	334.14
T_4	75 % RDNF through VC + 25% RDNF through urea	10.60	7.8	0.15	0.57	243.39	49.80	330.19
T_5	50 % RDNF through VC + 50% RDNF through urea	11.98	7.8	0.15	0.56	240.34	49.30	328.13
T_6	25 % RDNF through VC + 75% RDNF through urea	10.87	7.8	0.15	0.54	230.33	46.90	318.33
T_7	Seed inoculation with *Azospirillum* (Az)	6.78	7.7	0.16	0.47	200.62	38.86	296.00
T_8	Az + 25% RDNF through urea	7.53	7.7	0.16	0.47	203.51	39.97	297.29
T_9	Az + 50% RDNF through urea	8.22	7.7	0.16	0.48	208.69	41.60	299.32
T_{10}	Az + 75% RDNF through urea	9.61	7.7	0.16	0.49	219.32	42.80	300.17
T_{11}	100% RDNF through FYM	7.65	7.8	0.15	0.55	229.32	45.90	320.17
T_{12}	75% RDNF through FYM + 25% RDNF through urea	8.39	7.8	0.15	0.53	228.17	45.30	317.23
T_{13}	50% RDNF through FYM + 50% RDNF through urea	9.68	7.8	0.15	0.52	226.39	44.90	316.92
T_{14}	25% RDNF through FYM + 75% RDNF through urea	10.53	7.8	0.15	0.50	220.32	43.10	305.82
	SEm ±	0.40	0.02	0.005	0.014	2.90	0.98	4.42
	CD (0.05)	0.82	NS	NS	0.030	5.98	2.01	9.10

* RDNF = Recommended dose of nitrogen fertilizer VC = Vermicompost FYM = Farm Yard Manure

per cent RDNF) and 100 N (100 per cent RDNF through urea). The treatment details are given in Table 1, which were laid out in a randomized block design replicated thrice. Manuring and fertilization were done as per the treatments. Nitrogen, phosphorus and potassium were applied in the form of urea, single super phosphate and muriate of potash, respectively. Seed inoculation was done with *Azospirillum* @ 50 gm kg^{-1} of seed before sowing. All the treatments received an uniform dose of 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1}. The entire dose of phosphorus and potassium were applied as basal dressing only. Urea was however, applied in 3 equal splits; half as basal and the remaining half applied in two splits at 35 and 55 days after sowing. The nutrient composition of vermicompost and farm yard manure were given in Table 2.

Table 2 : Nutrient composition of manures used in the experiment

Nutrient	Vermicompost	Farm Yard Manure
N%	1.8	0.5
P%	1.5	0.38
K%	1.40	0.32
Fe (mg kg^{-1})	1400.3	308.8
Mn " "	300.5	189.2
Cu " "	69.3	27.2
Zn " "	130.4	50.8

Soil samples were collected just before start of the experiment and at harvest of the crop. The samples were analyzed for pH, EC, OC and available nutrient status using standard procedures as outlined by Jackson (1967). Seed yield was recorded as per the treatments and expressed as q ha^{-1}.

RESULTS AND DISCUSSION

The seed yield was significantly and positively influenced by substitution of recommended dose of inorganic fertilizer N with vermicompost and farm yard manure, seed inoculation with *Azospirillum* in combination with inorganic nitrogen (Table 1). All the treatments which received vermicompost in conjunction with urea (T_4 to T_6) recorded significantly higher grain yield compared to 100% RDNF through urea (T_2).

All the vermicompost combinations performed better than their corresponding combinations of farm yard manure and *Azospirillum* inoculation with seed. Similar increase in seed yield due to application of vermicompost was reported by Rajkhowa *et al.* (2000) which might be due to steady and increased availability of nutrient from vermicompost that has resulted in increased uptake of nutrients by plants and finally augmented the seed yield. However, the combination of 50% RDNF through VC + 50% RDNF through urea (T_5) recorded the highest seed yield over other treatmental combinations. This might be due to immediate release of N through urea and the latter by the mineralization of N through vermicompost resulting in steady supply of nutrients throughout the crop growth period. The results were in accordance with the findings of Gopal Reddy and Suryanarayan Reddy (1999).

The increase in seed yield by 50% RDNF through VC + 50% RDNF through urea over control and 100% RDNF through urea was 87.7 and 25.31 per cent, respectively.

The lowest seed yield was recorded by control (T_1) followed by *Azospirillum* inoculation with seed (T_7) which might be due to no supply of nitrogen in the control and low supply of nitrogen by the *Azospirillum* to an extent of 20 to 25 per cent only as reported by Natarajan *et al.* (1986) in sesamum.

Vermicompost (VC), farm yard manure (FYM) and seed inoculation with *Azospirillum* either alone or in conjunction with urea did not significantly influence soil pH (Table 1). This might be due to the buffering action of organic matter that is added to the soil. Gattani *et al.* (1976) reported similar results due to farm yard manure along with inorganic fertilizer. The electrical conductivity of the soil was not significantly influenced by various treatments (Table 1). Since the quantities of fertilizers were low and the crop was given good number of irrigations during the crop growth period and it is quite probable that the salt might have been leached down. Similar results were reported by Chaudhary *et al.* (1981) in experiments with organic manure.

The organic carbon conient and available macronutrient (N,P and K) status were significantly influenced by various treatments (Table 1). Among all the treatments, application of 100 per cent RDNF through VC (T_3) resulted in the highest organic carbon and available nitrogen, phosphorus and potassium, which was on par with 75% RDNF through VC + 25% RDNF through urea (T_4) and 50% RDNF through VC + 50% RDNF through urea (T_5). The manure treated plots recorded the highest increase in all the above properties compared to 100% RDNF through urea (T_2) and *Azospirillum* (T_7 to T_{10}) treated plots. This might be attributed to the direct addition and slow release of N, P and K through manures added to the soil. Bhardwaj and Omnwar (1994) also reported an increase in organic carbon content and available macronutrient status due to application of organic manures.

The highest buildup of available nitrogen in vermi compost treated plots might be due to the fact that organic matter and its passage through the gut of earthworms subject the material to the process of enzymatic digestion leading to the breakdown of complex organic compounds like protein, nucleic acids and the nitrogen containing organic compounds as reported by Vasanthi *et al.* (1995).

Sharma *et al.* (2001) reported that the highest available phosphorus recorded in manure treated plots might be due to the organic acids which were released during microbial decomposition of organic matter which helped in solubility of native phosphates, thus increasing the available phosphorus content in soil. Besides this, appreciable quantities of carbondioxide released during the decomposition of organic matter might have formed carbonic acid, which enhances the solubility of phosphates. However, the vermicompost treated plots recorded the highest available phosphorus which might be due to enhanced phosphatase activity, which contributed to increased availability of phosphorus. The results are in accordance with findings of Gopal Reddy and Suryanarayana Reddy (1999).

The buildup of available K in soil might be attributed to the direct addition of potassium to the available pool of the soil, besides the reduction of potassium fixation and release of potassium due to the interaction of organic matter with clay. Similar beneficial effects of organics on available K were reported in case of FYM by Bharadwaj *et al.* (1982).

The lower values of available nitrogen, phosphorus and potassium were observed in the treatment T_1 (control) and T_2 (100% RDNF through urea) at the time of harvest of the crop compared to other treatments which might be attributed to the maximum utilization of the soil available nutrients by the crop.

Among *Azospirillum* combinations, T_{10} (*Azospirillum* inoculation with seed + 75% RDNF through urea), recorded the highest available nitrogen phosphorus and potassium. All the *Azospirillum* treatments either alone or in conjuction with urea recorded higher available phosphorus and potassium contents, than T_1 (control) and T_2 (100% RDNF through Urea). This might be due to the release of phosphorus by the bacteria into the soil and also inorganically applied phosphorus to the soil might have been made available by the *Azospirillum*. High available potassium might be attributed to the release of potassium by *Azospirillum* in addition to nitrogen fixation. Venkat Ram Munireddy (1998) also reported that, *Azospirillum* inoculation with seed recorded the higher phosphorus and potassium compared to control and inorganic fertilizers alone.

The results indicate that application of 50% RDNF through VC + 50% RDNF through urea is needed to increase the yield of sunflower as well as improve the soil fertility.

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Cumulative Effects of Applied Phosphorus on Sunflower Grown in Hybrid Rice-Sunflower Sequence on An Alfisol

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ABSTRACT

Application of four levels of phosphorus to the first crop of rice and an uniform dose of P to the succeeding crop of sunflower exhibited significant yield increments in sunflower with each level of P added to previous crop of rice. This cumulative residual effect was significant upto P_{80} applied to rice. Phosphorus content and P uptake at 50% flowering as well as in seed and stalks were influenced significantly. However, the sunflower crop grown after hybrid APHR - I recorded more yields and uptake values than that of the crop grown after Tellahamsa.

Key Words : Cumulative, Hybrid, Rice, Sunflower, Sequence, Alfisol, Phosphorus.

Rice - sunflower cropping system is fast replacing the rice - groundnut cropping system, which is widely adopted in Northern Telangana - climatic zone of Andhra Pradesh. In recent years, the high yielding varieties of rice are gradually replaced by hybrid rice, which promises a yield increment of 15 to 20 per cent above the HYVs. However, hybrid rice removed more P than traditional or HYVs of rice (Shanti, 1998). Sunflower is a heavy feeder of nutrients, specifically applied as well as native. Alfisols, in which rice is cultivated under low land conditions, are in general poor in fertility. Phosphorus is dificient in Alfisols and taking up hybrid rice - sunflower in these soils would lead to further depletion of P from these soils. For better P nutrition of crops, it is imperative to study the direct effect of applied P on rice as well as its residual effects on the succeeding crop of sunflower. This will help to find out a dose of P that would serve the needs of both the crops grown in the sequence. Hence, in this paper, the cumulative effects of applied P on sunflower are presented.

MATERIAL AND METHODS

A field experiment was conducted at College farm, College of Agriculture, Rajendranagar on a sandy loam soil (Alfisol) during 1994-95. The soil was neutral in reaction (pH 7.0) and was non-saline (EC 0.179 dSm^{-1}). The OC was low (0.4 g Kg^{-1}). The available N, P_2O_5 and K_2O contents were 188.0, 8.8 and 336.1 Kg ha^{-1}, respectively. The P fixing capacity of soil was 18 per cent.

Hybrid rice (APHR -1) and a local popular rice variety Tellahamsa were grown during *kharif* with four levels of phosphorus (P_0 - 0 Kg P_2O_5 ha^{-1}, P_{30} - 30 Kg P_2O_5 ha^{-1}, P_{60} - 60 Kg P_2O_5 ha^{-1} and P_{90} - 90 Kg P_2O_5 ha^{-1}). After the harvet of *kharif* rice in the same layout, sunflower, (cv. Morden) was grown during *rabi*

Table 1 : Cumulative effect of levels of phosphorus on dry matter yields, P content and P uptake by sunflower at flowering (*rabi*, 1994 - 95)

P levels (Kg P_2O_5 ha^{-1})	Dry matter (t ha^{-1}) After APHR - 1	Dry matter (t ha^{-1}) After T.H.	P content (mg g^{-1}) After APHR - 1	P content (mg g^{-1}) After T.H.	P uptake (kg ha^{-1}) After APHR - 1	P uptake (kg ha^{-1}) After T.H.
P_0	2.46	2.25	1.46	1.45	3.52	3.25
P_{30}	3.13	2.39	1.62	1.62	5.09	3.86
P_{60}	3.38	2.41	1.67	1.66	5.65	4.04
P_{90}	3.50	2.55	1.89	1.81	6.47	4.63
Mean	3.12	2.40	1.66	1.63	5.18	3.94
S.Em (±)	0.13	0.13	0.03	0.01	0.24	0.22
C.D (0.05)	0.38	NS	0.10	0.04	0.72	0.67

T.H. : Tellahamsa; NS : Non Significant

with a recommended fertilizer dose (80 : 50 : 30 Kg ha^{-1} of N : P_2O_5 : K_2O) uniformly applied to all the plots. Thus, the cumulative doses of P_0,P_{50},P_{80}, P_{110} and P_{140} were applied to the rice - sunflower system as a whole. Plant samples were collected at 50 per cent flowering and at harvest of sunflower and the P content was estimated by Vanodo - molybdo phosphoric acid yellow colour method (Jackson, 1967).

RESULTS AND DISCUSSION

Dry matter yields, P content and P uptake at flowering

The cumulative effect of applied P (accounting to 50 (0 + 50), 80 (30 + 50), 110 (60 + 50) and 140 (90 + 50) Kg P_2O_5 ha^{-1}) on dry matter yields and P uptake by sunflower was significant, specifically when grown after hybrid rice (APHR - 1). In sunflower crop grown after Tellahamsa, dry matter production did not vary significantly with cumulative P levels. However, in sunflower grown after hybrid rice, the dry matter yields at P_{30}, P_{60} and P_{90} were on par with each other, while they significantly differed from P_0 level (Table 1). This difference could be due to low grain yields of rice hybrid (APHR -1) in the previous season (*kharif*) that resulted in poor uptake of applied P by the hybrid. Therefore, some amount of P could have been left out in soil under the hybrid as compared to the other rice genotype Tellahamsa.

Interaction effects showed that the dry matter yields of sunflower increased with increasing cumulative levels of applied P only when preceding genotype was hybrid and significant effects were seen only upto P_{30} (Table 2). Responses of sunflower, through increase in dry matter production to applied P levels were reported by several workers (Dravid and Goswami, 1988; Singh *et al.*, 1994; Singh and Bishnoi, 1994; Reddy *et al.*, 1997).

The increase in P content of sunflower at flowering, grown after either of the rice genotypes was found non significant between P_{30} and P_{60} levels. However, the increase between P_{90} and P_0 levels was 29 per cent when grown after APHR -1 and 25 per cent when grown after Tellahamsa (Table 1). The P uptake by sunflower showed an increase at the cumulative dose of

Table 2 : Interaction effects of genotypes and levels of P applied to rice on dry matter yields, P content and P uptake by sunflower at flowering (*rabi*, 1994 - 95)

P levels	Dry matter ($t\ ha^{-1}$)			P content ($mg\ g^{-1}$)			P uptake ($kg\ ha^{-1}$)		
($Kg\ P_2O_5\ ha^{-1}$)	After APHR - 1	After T.H.	Mean	After APHR - 1	After T.H.	Mean	After APHR - 1	After T.H.	Mean
P_0	2.46	2.25	2.35	1.46	1.45	1.45	3.52	3.25	3.99
P_{30}	3.13	2.29	2.76	1.62	1.62	1.62	5.09	3.86	4.47
P_{60}	3.38	2.41	2.90	1,697	1.67	1.67	5.65	4.04	4.84
P_{90}	3.50	2.55	3.03	1.89	1.81	1.85	6.47	4.63	5.55
Mean	3.12	2.40	2.56	1.66	1.63	1.62	5.18	3.94	4.56
	S.Em (±)	**C.D (0.05)**		**S.Em (±)**	**C.D (0.05)**		**S.Em (±)**	**C.D (0.05)**	
G	0.07	0.19		0.01	NS		0.11	0.32	
P	00.9	0.26		0.02	0.05		0.16	0.45	
G x P	0.13	0.37		0.03	NS		0.22	0.64	

T.H. : Tellahamsa; NS : Non Significant G.: Genotypes; P: Phosphorus levels

80 Kg P_2O_5 ha^{-1} (P_{30}) which was, however, on par with P_{110} when grown after either of the rice genotypes. The P uptake by sunflower crop grown after hybrid was higher than after the variety; the mean values being 5.18 and 3.94 Kg ha^{-1}, respectively. The interaction between genotypes of rice and P levels showed significant effects on P uptake by crop. The P uptake by sunflower (after hybrid) at the cumulative dose of P_{50} was on par with P uptake (after Tellahamsa) even at P_{110} level. Similarly, P uptake by sunflower grown after Tellahamsa at P_{140} (4.63 Kg ha^{-1}) was on par with its P uptake after hybrid at P_{80} (5.19 Kg ha^{-1}).

Yields, P content and P uptake by sunflower at harvest

The data on effect of cumulative P levels on yields of sunflower are presented in Table 3 and 4. The yields of seed and stalks increased with increasing levels of applied P, while the increase in seed yield with increase in cumulative dose of P was significant upto P_{110}, it was not significant in respect to stalk yields of sunflower. Highest seed yields of 1267 Kg ha^{-1} was observed when sunflower was grown after hybrid (APHR -1) at P_{140} level. On the other hand, highest stalk yields of 1959 Kg ha^{-1} was noticed at same level of P (P_{140}) but when grown after Tellahamsa. The interaction effect between the genotypes of rice and P levels on seed yield was not significant while individually they showed significant influence on seed yield of sunflower. In general, sunflower grown after APHR - 1 showed more seed yield.

Response of sunflower to directly applied P were reported by Tripathi and Kalra (1980), Singhi and Pacheria (1987), Misra and Sen (1986), Megur *et al.* (1993), Mishra *et al.* (1995) and Bhal *et al.* (1997). They further reported increase in root growth, leaf area index, size of seed *etc.*, and ultimately increase in seed yield due to application of P to this crop.

Gill and Meelu (1983) observed cumulative effect of phosphorous applied to rice

Table 3 : Cumulative effect of added P on dry matter yields, P content and P uptake by sunflower at maturity (*rabi*, 1994 - 95)

P levels (Kg P_2O_5 ha^{-1})	Seed: Seed Yield (Kg ha^{-1})		Seed: P Content (mg g^{-1})		Seed: P uptake (Kg ha^{-1})		Stalk: Stalk Yield (Kg ha^{-1})		Stalk: P content (mg g^{-1})		Stalk: P uptake (Kg ha^{-1})		Total drymatter (Kg ha^{-1})		Total P uptake (Kg ha^{-1})	
	After APHR - 1	After T.H.	After APHR - 1	After T.H.	After APHR - 1	After T.H.	After APHR - 1	After T.H.	After APHR - 1	After T.H.	After APHR - 1	After T.H.	After APHR - 1	After T.H.	After APHR - 1	After T.H.
P_0	1031	807	1.76	1.75	1.82	1.41	18.02	1831	0.87	0.56	1.57	1.03	2833	2638	3.39	2.45
P_{30}	1118	939	2.10	1.85	2.35	1.74	1880	1878	1.16	0.69	2.19	1.29	2998	2817	4.53	3.02
P_{60}	1195	1027	2.39	1.97	2.86	2.02	1903	1912	1.27	1.00	2.43	1.92	3098	2938	5.29	3.93
P_{90}	1267	1028	2.33	2.08	3.08	2.13	1911	1959	1.47	1.10	2.81	2.16	31.78	2987	5.59	4.29
Mean	1153	950	2.17	1.91	2.52	1.82	1874	1895	1.20	0.84	2.25	1.60	3027	2845	4.77	3.42
S.Em	22.14	29.86	0.05	0.04	0.05	0.06	37.52	37.67	0.02	0.02	0.05	0.06	34.11	42.68	0.06	0.08
C.D (0.05)	66.71	89.99	0.14	0.13	0.15	0.19	NS	NS	0.06	0.07	0.15	0.19	102.80	128.61	0.18	0.25

G : Genotypes; P: Phosphorus levels NS : Non Significant T.H. : Tellahamsa;

as well as wheat in a rice - wheat cropping system in a low P loamy sand of Ludhiana. Similarly Singaram and Kothandaraman (1991) studied cumulative residual effects of P in a fingermillet - maize - blackgram cropping system. When fertilizer P was added to both fingermillet and maize significant increase in grain yield upto P_{90} in maize was found while no. of cobs / plant and stalk yields were unaffected.

Similar trends were also reported in pigeon pea - wheat (Modak *et al.*, 1997) maize - finger millet (Singaram and Kotandaraman, 1994) and rice - groundnut (Ramasheshaiah *et al.*, 1980 and Muthuvel *et al.*, 1991) cropping systems.

The cumulative effect of applied P on P content of seed grown after hybrid rice was significant only upto P_{110} level. The stalk P content also showed significant increase with increase in level of added P when sunflower was grown after either of the rice genotypes. The highest P contents in seed (2.43 mg g^{-1}) as well as in stalk (1.47 mg g^{-1}) were observed at P_{140} level in crop growth after hybrid rice. The interaction effects were found significant in this regard (Table 4).

The seed P uptake increased significantly upto P_{140} level in crop grown after APHR -1 and upto P_{110} in crop grown after Tellahamsa under the influence of cumulated application of P when preceding genotypes were hybrid and Tellahamsa, respectively.

The results of this study indicate that though an uniform dose of P (50 Kg P_2O_5 ha^{-1}) was applied to sunflower, the effects of phosphorus applied to preceding genotype of rice exhibited a definite effects on dry matter

Table 4 : Interaction effects of genotypes and P levels applied to rice on yields. P content and P uptake by sunflower at maturity (*rabi*, 1994 - 95)

P levels (Kg $P_2O_5ha^{-1}$)	After APHR - 1	After T.H.	Mean	After APHR - 1	After T.H.	Mean	After APHR - 1	After T.H.	Mean
		Yield (kg ha^{-1})			Seed P content (mg g^{-1})			P uptake (kg ha^{-1})	
P_0	1031	808	919	1.76	1.75	1.76	1.62	1.41	1.62
P_{30}	1118	939	1029	2.10	1.85	1.97	2.35	1.74	2.04
P_{60}	1195	1025	1110	2.39	1.97	2.18	2.86	2.02	2.44
P_{90}	1267	1028	1147	2.43	2.08	2.25	3.08	2.13	2.60
Mean	1153	950	1052	2.17	1.91	2.04	2.52	1.82	2.17
	S.Em (±)	**C.D (0.05)**		**S.Em (±)**	**C.D (0.05)**		**S.Em (±)**	**C.D (0.05)**	
G	14.29	41.04		0.02	0.06		0.03	0.08	
P	20.21	58.04		0.3	0.09		0.04	0.13	
G x P	28.58	NS		0.04	0.12		0.06	0.18	
		Yield (kg ha^{-1})			Stalk P content (mg g^{-1})			P uptake (kg ha^{-1})	
P_0	1802	1831	1816	0.87	0.56	0.72	1.57	1.03	1.30
P_{30}	1880	1878	1879	1.16	0.69	0.92	2.19	1.29	1.74
P_{60}	1903	1912	1908	1.27	1.00	1.14	2.43	1.92	2.18
P_{90}	1911	1959	1935	1.47	1.10	1.29	2.81	2.16	2.40
Mean	1874	1895	1885	1.20	0.84	1.02	2.25	1.60	1.93
	S.Em (±)	**C.D (0.05)**		**S.Em (±)**	**C.D (0.05)**		**S.Em (±)**	**C.D (0.05)**	
G	10.16	NS		0.01	0.03		0.03	0.08	
P	27.10	77.84		0.01	0.04		0.04	0.11	
G x P	38.33	NS		0.02	0.06		0.05	0.16	
		Total dry matter (kg ha^{-1})				Total P uptake (kg ha^{-1})			
P_0	2833	2638	2735		3.39	2.45	2.92		
P_{30}	2998	2817	2907		4.53	3.02	3.78		
P_{60}	3098	2938	3018		5.39	3.93	4.61		
P_{90}	3178	2987	3082		5.89	4.29	5.09		
Mean	3027	2845	2936		4.77	3.42	4.10		
	S.Em (±)	**C.D (0.05)**			**S.Em (±)**	**C.D (0.05)**			
G	19.95	57.29			0.04	0.11			
P	28.20	81.03			0.05	0.15			
G x P	39.89	NS			0.08	0.22			

G : Genotypes; P: Phosphorus levels NS : Non Significant T.H. : Tellahamsa;

yields and seed yields of *rabi* sunflower crop. However, these responses to cumulative doses of P were very low under field conditions.

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Status and Depletion of Soil N, P and K Fractions at Harvest of Blackgram Grown on Residual Fertility in a Hybrid Rice - Blackgram Cropping Sequence

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ABSTRACT

Cropping system involving hybrid rice during *Kharif* and blackgram during *rabi* was studied under the influence of high levels of N,P and K fertilizer applied to *kharif* rice. Blackgram was grown on pure residual fertility. The soil inorganic fractions of N, P and K were studied. After harvest of rice the soil showed highest contents of these fractions in those treatments which received highest levels of these nutrients, respectively. Even after the harvest of rabi blackgram the trend remained same. There was a depletion in N fractions after harvest of blackgram despite the fact that leguminous blackgram fixes atmospheric nitrogen. Among P fractions the depletion at harvest of blackgram followed the order S-P>Ca-P> Al-P>Rs-P>Fe-P indicating that S-P and Ca-P are preferred forms of P by blackgram. Exchangeable K was the most depleted fraction among other inorganic K fractions.

Key Words ; Depletion Fractions, Residual Fertility.

Hybrid rice though a recent introduction in India, is gradually gaining popularity by virtue of its high yield potential. On account of its higher fertilizer responsiveness it could be grown on higher levels of N, P and K so that the crop yields would be boosted besides helping the succeeding *rabi* crop to yield substantially due to residual effects. The yields and fertilizer responsiveness of these two crops was well understood when compared to that of its depletion of nutrients from soil in a single crop or in a cropping sequence. Therefore, this work attempts to study the effect of high levels of N, P and K application to rice (hybrid) on status of these nutrient fractions at harvest of crops in hybrid rice - legume (blackgram) cropping sequence on Alfisol of Hyderabad.

MATERIAL AND METHODS

The field experiment was conducted at student's farm, college of Agriculture, Rajendranagar during 1996 - 97 and the soil characteristics were, pH 7.95, E.C 0.84 dS m^{-1}, available N 160.16 kg ha^{-1}, available P_2O_5 81-76 Kg ha^{-1}, available K_2O 282.24 Kg ha^{-1} while the status of micronutrients Zn, Cu, Mn and Fe were 2.45, 2.70, 7.75 and 11.5 ppm, respectively. Soil is basically a sandy loam with 76.3% sand, 4.8% silt and 18.9% clay contents.

The *kharif* rice crop was laid out with 12 treatments and 3 replications in a simple randomized block design. The treatments were fixed based on the analysis of soil for major and micronutrients. High levels of N, P and K were

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* PPIC (India Programme)

Table 1: Status of inorganic N,P and K fractions in soil after harvest of *kharif* rice

Treatment No.	Treatment Particulars (Kg ha^{-1})			Contents									
	N	P_2O_5	K_2O	NO_3-N	NH_4-N	Ws-K	Ex-K	Fixed -K	S-P	RS-P	Al-P	Fe-P	Ca-P
T_1	170	110	110	35.60	147.80	33.70	181.90	309.70	4.93	45.37	31.47	44.73	41.10
T_2	120	110	110	34.40	136.50	29.40	171.30	245.70	4.43	45.20	32.23	43.87	42.20
T_3	220	110	110	44.70	160.00	32.20	171.30	263.80	4.73	42.53	34.07	46.00	44.30
T_4	170	80	110	34.60	154.30	33.50	170.60	308.30	4.00	40.37	30.73	42.77	40.90
T_5	170	140	110	37.70	151.70	28.80	166.40	309.70	5.33	50.47	38.20	50.03	50.77
T_6	170	110	80	36.10	150.50	23.90	152.20	254.30	4.70	43.90	32.83	44.53	41.23
T_7	170	110	140	35.80	155.20	43.10	181.40	314.30	4.83	43.73	32.20	42.97	41.87
T_8*	170	110	110	35.60	149.20	33.60	170.60	262.50	4.80	43.73	33.00	48.73	41.70
T_9□	170	110	110	35.30	148.80	24.20	163.50	309.30	4.73	43.00	32.90	49.13	42.53
T_{10}+	170	110	140	35.50	146.70	24.00	163.30	263.50	5.90	43.43	31.90	48.40	43.47
T_{11}	120	80	30	32.50	145.70	22.70	146.90	234.80	3.67	38.60	29.90	42.73	42.47
T_{12}	Absolute control			22.00	119.80	22.30	132.20	209.70	3.00	32.30	28.23	35.47	36.77
	Mean			35.00	147.19	29.30	164.4	273.80	4.59	42.72	32.31	44.95	42.44
	S.Em (±)			1.56	3.74	0.68	1.59	1.30	0.45	0.74	0.74	0.86	0.98
	C.C (0.05)			3.24	7.76	1.40	3.31	2.69	0.93	2.16	1.54	1.78	2.05

* without Fe □ without Mn + without Zn

Treatments T_1 to T_{10} received Fe, Mn and Zn @ 34,6 and 5 Kg ha^{-1}, respectively.

applied besides taking care to supply micronutrients so that they would not become limiting for obtaining high yield. Iron, zinc and manganese were applied @ 34, 6 and 5 kg ha^{-1}, respectively. The treatment details are given in Table 1. Thirty five days old seedlings of hybrid rice were transplanted with a spacings of 20cm x 15 cm. During *rabi* after bringing the soil to favourable tilth, blackgram was grown in line spacing in the same plots as that of *kharif* rice adopting a spacing of 30cm x 10cm. No fertilizers were applied to blackgram. The source of N,P and K used for blackgram were Urea, SSP and MOP. Samples of soil were collected immediately after harvest of each crop. The inorganic fractions of P in soil were analyzed by procedure described by Chang and Jackson (1957). The inorganic fractions of N *viz;* NH_4^+ and NO_3^- were estimated in 2M KCl extracts of soil (Bremner, 1965) by following the procedures of Keeney and Nelson (1982) as described by Page (1982). The exchangeable K fraction was estimated by procedure given by Muhr *et al.* 1965.

Table 2: Status of inorganic N,P and K fractions in soil after harvest of *rabi* - blackgram

Treatment No.	Treatment Particulars (Kg / ha)			Contents									
	N	P_2O_5	K_2O	NO_3-N	NH_4-N	Ws-K	Ex-K	Fixed -K	S-P	RS-P	Al-P	Fe-P	Ca-P
T_1	170	110	110	22.60	136.90	32.20	176.70	302.50	3.70	40.87	26.86	36.93	33.93
T_2	120	110	110	21.20	127.70	28.10	166.90	234.30	3.53	40.60	29.46	36.80	36.50
T_3	220	110	110	36.10	150.40	30.80	168.30	249.60	3.76	38.67	30.76	38.10	31.47
T_4	170	80	110	20.00	142.90	32.30	168.20	294.10	3.23	37.87	26.17	33.00	33.27
T_5	170	140	110	28.20	142.00	26.00	162.60	295.80	4.03	45.43	31.43	39.65	37.50
T_6	170	110	80	23.80	141.40	22.10	147.10	241.60	3.80	41.47	27.80	37.73	35.53
T_7	170	110	140	25.80	149.80	41.60	176.00	306.10	3.40	40.00	27.27	35.53	35.07
T_8*	170	110	110	22.70	140.80	31.80	164.30	353.30	3.47	41.57	28.06	35.50	35.13
T_9□	170	110	110	22.30	140.20	21.90	154.60	296.40	3.77	39.77	28.43	35.90	34.87
T_{10}+	170	110	140	24.10	137.40	22.10	158.50	250.70	3.63	38.47	28.23	37.40	36.43
T_{11}	120	80	30	25.00	127.30	20.90	137.80	221.80	3.10	34.13	25.90	34.90	36.60
T_{12}	Absolute control			16.80	110.10	22.10	124.50	203.40	2.47	30.83	24.30	34.17	30.60
	Mean			24.06	137.23	27.70	158.70	270.80	3.49	39.14	27.89	36.30	34.74
	S.Em (±)			1.53	3.25	0.64	1.78	0.86	0.12	1.30	0.59	0.72	0.93
	C.C (0.05)			3.16	6.74	1.32	3.70	2.52	0.26	2.70	1.72	1.50	1.92

* without Fe □ without Mn + without Zn

Treatments T_1 to T_{10} received Fe, Mn and Zn @ 34,6 and 5 Kg ha^{-1}, respectively.

RESULTS AND DISCUSSION

Nitrogen fractions

The NO_3-N and NH_4-N fractions of soil inorganic nitrogen at harvest of rice were found to be highest in T3 (44.7 Kg ha^{-1} and 160 Kg ha^{-1} of NO_3-N and NH_4-N, respectively), the treatment that received the highest quantity of N than all other treatments (Table 1). The contents of these fractions in all other treatments were almost on par with each other, except in the T_{11} and T_{12} treatments. The trends of these fractions was seen in absolute control to which no nutrient was added and this was followed by the state recommended fertilizer treatments. The trends of these fractions were same even after harvest of *rabi* blackgram (Table 2). However, there was depletion of N fractions despite the fact that the blackgram fixes atmospheric N. The depletion of NO_3-N was more than the NH_4-N in all the treatments. The depletion of NO_3-N was 26.96% in control plots and 31.4% over all the plots proving that greater the content of available N greater is the depletion (Table 3).

Table 3: Depletion of nutrient fractions from control plots and overall treatments at harvest of blackgram

Nutrient	Fractions	Content in control plots		Depletion (%)	Mean content of overall plots		Depleton (%)
		after rice	after blackgram		after rice	after blackgram	
N(Kgha-1)	NO_3-N	23.00	16.80	26.96	35.00	24.06	31.40
	NH_4-N	119.80	110.10	8.10	147.19	137.23	7.00
Phosphorus (ppm)	S-P	3.00	2.47	17.67	4.59	3.49	23.97
	RS-P	32.30	30.83	4.55	42.72	39.14	8.38
	Al-P	28.23	24.30	13.92	32.31	27.89	13.68
	Fe-P	35.47	34.17	3.67	44.95	36.30	19.24
	Ca-P	36.77	30.60	16.78	42.44	34.74	18.14
Potassium (Kgha^{-1})	Ws-K	22.30	22.10	0.89	29.30	27.70	5.50
	Ex-K	133.20	124.50	6.53	164.40	158.7	3.40
	Fixed -K	209.70	203.40	3.00	273.80	270.80	1.10

Phosphorus Fractions

The data in Table 1 shows the status of P fractions *viz.,* S-P, Al-P, RS-P, Fe-P and Ca-P at harvest of hybrid rice, while Table 2 indicates that at the harvest of *rabi* blackgram. Blackgram to which no fertilizer was added depleted Ca-P significantly. The treatment T_5 showed highest content of these fractions at the harvest of both hybrid rice and blackgram i.e., the treatment which received the highest content of P in the previous crop of hybrid rice. The lowest was observed in T_{12} followed by T_{11}. The exact P depletion pattern of blackgram is understood through the P fraction status of inorganic P fractions in a cropping system were studied by Dhillon and Dev (1990) in rice-wheat cropping system on a sandy loam soil. When phosphorus was applied @ 0 to 240 Kg P_2O_5 ha^{-1} to the rice - wheat system together, there was drastic increase in saloid - P and Fe-P contents from initial to two years after rotation. However, the Al-P and Ca-P contents reduced below their initial status when MOP was applied. Studying the first residual, second residual and cumulative residual effects at harvest of blackgram in a finger millet - maize - blackgram sequence, Singaram and Kothandaraman (1994) observed that the status of S-P, Al-P, Fe-P, RS-P and Ca-P was increasing though not significantly with increase in levels of P application from 30 to 90 Kg P_2O_5 ha^{-1}.

Potassium fractions

The mean water soluble K content of 29.3 Kg ha^{-1}, exchangeable K of 164.4 Kg ha^{-1} and fixed K content of 273.8 Kg ha^{-1} was observed at the harvest of *kharif* rice (Table 1). However, the status was reduced to 27.7, 158.7 and 270.8 Kg ha^{-1} of Ws-K, Ex-K and fixed K, respectively at harvest of *rabi* blackgram. The Ex-K fraction was depleted to greater extent than other fractions. The depletion of Ex-K in control plots was 6.53% followed by 3.00% of fixed - K and 0.89% of Ws-K showing that Ws-K is constantly recouped from the exchangeable source of K which actually undergoes depletion during crop growth, though slightly replenished from fixed K source (Table3). On the contrary in the plots when fertilizer was applied to previous *kharif* rice the depletion of Ws-K was more than the Ex-K and fixed - K.

Vanaja (2000) reported similar results working on a rice - sunflower cropping sequence. The contents of inorganic N, P and K fractions depleted at harvest of sunflower when no noranic manure was added.

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Physical Nature and Fertility Status of Soils of Singarayakonda Mandal in Prakasam District of Andhra Pradesh

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ABSTRACT

The soils of Singarayakonda Mandal were developed from different parent materials of granite - gneiss, gneiss with ferruginous concretions and marine deposits. The texture was sandy clay loam to clay in black soils, sandy loam to clay in red soils and sandy in sand soil. Soil reaction was slightly alkaline to moderately alkaline (black soils) and acidic to moderately acidic (red soils). Cation exchange capacity was low to high with high per cent base saturation. The available nitrogen and phosphorus were low to medium while potassium was well supplied. The copper and manganese were sufficient. But zinc and iron were deficient in red soil, iron however, was sufficient.

Key Words : Physical nature, Fertility Status, Singarayakonda Mandal.

The most important soil groups in the state of A.P. as reported by Raman *et al.* (1985) are red and laterite soils occupying sixty per cent and black soils which occupy twenty five per cent of the geographical area. Black soils are fertile. Low infiltration rate, poor drainage and salinity are the constraints. Red soils are highly variable in nature and are subjected to soil erosion, drought, crust formation *etc.*

MATERIAL AND METHODS

Soil samples were collected horizonwise from representative pedons. The samples were air dried under shade and pounded with wooden hammer and passed through 2 mm sieve. The soils were then analysed for physical and chemical properties following standard procedures (Jackson, 1973).

RESULTS AND DISCUSSION

Black soils and red soils were slightly alkaline to moderately alkaline and acidic to moderately acidic in reaction, respectively whereas, sandy soils were neutral in reaction. Black and red soil pedons have shown sandy clay more or less uniform. The bulk density was higher in the sub-surface horizons in all the pedons due to the compact nature of soil. The water holding capacity of black soil was higher than others and this was because of high clay content. Similar trend was recorded with volume expansion and sticky point also (Table 1).

Available Nutrients

The available nitrogen and phosphorus contents were low to medium in all the pedons because of low organic matter content. A

Table 1 : Physical properties of the soils

Horizon & pedon	Depth (m)	Bulk density Mg m^{-3}	Particle density Mg m^{-3}	Water holding capacity %	Pore space %	Volume expansion %	Sticky point %
1. AP	0.00 - 0.09	1.41	2.43	31.35	41.97	4.40	13.35
AP_2	0.09 - 0.25	1.43	2.45	32.40	41.63	4.60	14.40
Bt_1	0.25 - 0.42	1.46	2.46	33.80	40.65	5.00	15.25
Bt_2	0.42 - 0.69	1.48	2.48	34.02	40.32	4.70	16.08
C	0.69 - 1.18	1.50	2.45	33.25	38.77	4.60	16.75
2. AP	0.00 - 0.06	1.29	2.55	46.00	49.41	26.50	31.30
B	0.06 - 0.39	1.35	2.51	49.50	46.21	27.00	34.00
Bss1	0.39 - 0.65	1.36	2.56	52.60	46.87	27.82	34.51
Bss2	0.65 - 0.92	1.41	2.60	56.40	45.76	30.59	35.00
Bss3	0.92 - 1.24	1.48	2.52	57.65	41.26	31.00	38.45
AC	> 1.24	1.54	2.58	60.75	40.31	32.43	39.00
3. AP	0.00 - 0.08	1.32	2.60	50.00	49.23	25.60	32.40
B_1	0.08 - 0.32	1.34	2.54	49.55	47.24	28.40	33.60
B_2	0.32 - 0.64	1.41	2.60	52.66	45.76	29.30	36.56
B_{w1}	0.64 - 0.77	1.46	2.52	56.00	42.06	31.40	39.40
B_{w2}	0.77 - 1.08	1.52	2.58	58.00	41.08	33.50	41.00
4. AP	0.00 - 0.011	1.31	2.58	47.50	49.22	27.50	34.50
B_{w1}	0.11 - 0.24	1.36	2.54	51.00	46.25	27.00	35.00
B_{w2}	0.24 - 0.52	1.40	2.41	52.50	41.90	29.50	37.50
B_{ss1}	0.52 - 0.87	1.47	2.60	56.00	43.46	31.50	39.50
B_{ss2}	0.87 - 1.32	1.48	2.52	58.90	41.26	32.85	41.85
AC	1.32+	1.50	2.57	59.75	41.63	34.50	42.00
5. AP	0.00 - 0.09	1.49	2.56	18.75	41.79	0.23	--
B	0.09 - 0.34	1.52	2.49	18.15	38.95	0.20	--
C_1	0.34 - -0.69	1.54	2.62	17.25	41.22	0.18	--
C_2	0.69 - 0.94	1.63	2.60	16.45	37.30	0.18	--
C_3	0.94 - 1.36	1.60	2.59	15.25	38.22	0.16	--
C_4	1.36+	1.61	2.57	14.75	37.35	0.17	--
6. AP	0.00 - 0.16	1.42	2.44	30.13	41.80	5.65	13.56
B	0.16 - 0.54	1.44	2.49	31.05	42.16	5.80	14.25
B_{t1}	0.54 - 0.78	1.47	2.50	32.90	41.20	6.01	15.08
B_{t2}	0.78 - 1.02	1.51	2.53	33.70	40.71	4.80	15.90
B_{t3}	1.02 - 1.27	1.49	2.50	33.95	40.40	4.75	16.72
C	1.27+	1.47	2.48	32.70	40.72	4.66	17.01
7. AP	0.00 - 0.011	1.37	2.52	30.75	45.63	4.25	15.41
B_{w1}	0.11 - 0.35	1.43	2.50	31.62	42.80	4.56	15.91
B_{w2}	0.35 - 0.72	1.46	2.53	27.05	42.29	5.01	17.00
B_{t1}	0.72 - 1.12	1.50	2.54	30.04	40.94	4.60	17.25
C	> 1.12	1.51	2.51	32.51	39.84	4.65	17.90

Table 2 : Available nutrients (mg kg^{-1}) of the soils

Horizon & pedon	Depth (m)	Available Nutrients							
		N	P	K	S	Zn	Cu	Fe	Mn
1. AP	0.00 - 0.09	129	14.2	225	17.6	0.52	1.86	21.00	27.60
AP_2	0.09 - 0.25	110	12.4	210	15.0	0.48	1.84	19.00	27.60
Bt_1	0.25 - 0.42	89	11.0	175	12.8	0.32	1.82	18.50	26.00
Bt_2	0.42 - 0.69	81	8.9	160	11.4	0.56	1.71	15.60	24.50
C	0.69 - 1.18	67	6.0	150	10.6	0.51	1.62	14.00	20.00
2. AP	0.00 - 0.06	145	20.5	291	24.5	0.92	3.64	9.50	20.60
B	0.06 - 0.39	131	20.0	287	20.0	0.98	2.20	8.00	20.20
Bss1	0.39 - 0.65	110	14.4	285	17.5	1.60	3.92	7.50	21.60
Bss2	0.65 - 0.92	96	10.6	223	12.6	1.66	2.16	6.70	20.00
Bss3	0.92 - 1.24	79	8.3	201	15.6	0.94	2.40	6.60	20.00
AC	> 1.24	70	5.9	196	11.9	0.91	2.06	5.90	20.80
3. AP	0.00 - 0.08	151	22.0	301	23.5	0.88	2.32	18.00	23.20
B_1	0.08 - 0.32	136	12.5	284	19.4	0.80	2.31	16.60	25.20
B_2	0.32 - 0.64	112	15.6	240	16.8	0.74	2.38	16.50	21.20
B_{w1}	0.64 - 0.77	86	12.1	192	11.9	0.61	2.36	14.00	19.10
B_{w2}	0.77 - 1.08	64	7.9	186	10.8	0.62	2.38	14.80	20.80
4. AP	0.00 - 0.011	156	19.5	289	20.5	0.96	2.00	11.50	23.60
B_{w1}	0.11 - 0.24	139	17.1	251	21.0	1.08	2.38	10.10	21.00
B_{w2}	0.24 - 0.52	120	16.0	232	16.5	0.94	2.38	9.75	23.00
B_{ss1}	0.52 - 0.87	76	15.4	186	12.1	0.91	2.26	8.50	18.80
B_{ss2}	0.87 - 1.32	70	11.0	171	10.2	0.87	2.12	8.00	21.20
AC	1.32+	64	6.5	140	9.6	0.88	2.17	7.60	21.00
5. AP	0.09 - 0.34	92	5.1	132	5.1	0.54	1.41	2.76	17.40
C_1	0.34 - -0.69	67	4.2	119	4.2	0.56	1.28	2.34	17.60
C_2	0.69 - 0.94	51	4.6	112	3.1	0.36	1.70	2.30	15.60
C_3	0.94 - 1.36	40	3.1	99	2.8	0.34	1.62	2.15	16.25
C_4	1.36+	36	2.9	89	2.1	0.29	1.31	2.00	15.80
6. AP	0.00 - 0.16	121	15.0	240	18.0	0.56	2.68	21.00	22.60
B	0.16 - 0.54	103	13.4	225	14.0	0.58	2.06	20.00	22.20
B_{t1}	0.54 - 0.78	72	12.0	182	15.0	0.56	1.74	19.50	21.80
B_{t2}	0.78 - 1.02	65	10.6	171	11.6	0.49	1.62	17.50	22.40
B_{t3}	1.02 - 1.27	60	8.2	162	8.9	0.41	1.74	13.00	20.20
C	1.27+	56	7.1	149	7.2	0.38	1.61	11.50	20.00
7. AP	0.00 - 0.11	130	14.7	247	17.9	0.47	1.10	19.00	20.20
B_{w1}	0.11 - 0.35	119	13.0	210	15.2	0.44	1.28	16.50	17.20
B_{w2}	0.35 - 0.72	102	12.6	192	13.1	0.42	1.54	14.00	16.40
B_{t1}	0.72 - 1.12	86	10.5	171	10.5	0.41	1.80	13.00	19.80
C	> 1.12	61	8.6	154	8.2	0.39	1.71	11.00	17.20

significant positive correlation was observed between organic carbon and available nitrogen (r = 0.84) and phosphorus (r = 0.82). The surface horizons of all the pedons have invariably recorded higher availability of sulphur than sub surface layers. A significant positive correlation (r = 0.67) was found between organic carbon and available sulphur.

Less available zinc in deeper layers was due to low amount of organic carbon in deeper layers. The available zinc was significantly and positively correlated with organic carbon (r = 0.69). Khan *et al.* (1997), Patel and Malewar (1998) observed similar correlations.

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Evaluation of Imidacloprid 200 SL Applied in Nursery Against Whorl Maggot and Thrips in Rice in Mainfield

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ABSTRACT

Different treatments with imidacloprid 200 SL along with carbofuran 3 G applied in rice nursery, before pulling, were evaluated against whorl maggot and thrips in main field during *kharif* 1999. Minimum damage due to whorl maggot was recorded with foliar application 5 Days Before Pulling (DBP) @ 25 g a.i.ha^{-1}. Higher doses in both soil and foliar application increased its incidence. Imidacloprid was found ineffective and favouring the incidence of thrips as the damage percentage was found to be high in all the treatments at both 15 and 30 DAT.

Key Words : Rice nursery, Whorl maggot, Thrips, Imidacloprid 200 SL.

Rice is the primary staple food for more than two billion people in Asia. Out of 100 species of insect pests affecting rice crop, 20 were considered to be major. Thrips and whorl maggot are two pests considered to be of minor importance in rice environment especially thrips occurring during drought years. Thrips are mainly pests of rice seedlings although recorded during the heading stage. Damage due to whorl maggot appears in the form of stunted growth in crop. In the present investigation, imidacloprid 200 SL, a new insecticide belonging to chloronicotinyl group has been used to test its efficacy in rice nursery before pulling as the research regarding the same was not conducted so far.

MATERIAL AND METHODS

Different treatments with imidacloprid 200 SL *viz.*, sprouted seed soaking @ 0.05 per cent for 3 hr before sowing, sprouted seed soaking and drenching @ 75g a.i.ha^{-1} at 5 DBP, soil application at 10 DBP @ 25 g and 37.5g a.i. ha^{-1}, foliar application @ 25g and 37.5g a.i.ha^{-1} at 5 DBP were used. Also carbofuran 3 G applied 5 DBP @ 1.5 kg a.i.ha^{-1} as check and an untreated control were included. All the treatments were laid out in a randomised block design with four replications. Tellahamsa, a popular rice variety susceptible to insect pests was planted at 15 x 15 cm spacing. All the recommended agronomic practices were followed for raising the crop.

Method of application

i) Sprouted seed treatment : The sprouted seeds were soaked in solution of imidacloprid for 3 hrs and the seeds were carefully removed

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and dried and broadcasted on raised nursery bed.

ii) Drenching : Required test insecticide was mixed with water and the nursery was drenched and allowed till next irrigation.

iii) Soil application: Required test insecticide was measured and added to water (10 ml). The solution was mixed with sand (200 g). It was mixed thoroughly and broadcasted to nursery 5 DBP.

iv) Foliar spray : Required test insecticide was mixed with water and sprayed on nursery by knapsack sprayer.

The incidence of whorl maggot was assessed by counting the total damaged leaves and total number of leaves in 10 hills selected at random. Similarly thrips damage was recorded on 10 hills, selected at random by counting the total number of leaves and the total damaged leaves.

Observations for both the pests were recorded at 15 and 30 DAT and was subjected to statistical analysis.

RESULTS AND DISCUSSION

Whorl Maggot

The data (Table) indicated significant differences among the treatments at 15 DAT, but did not reach the level of significance at 30 DAT. Damaged leaves due to the whorl maggot were minimum with foliar application @ 25g a.i. ha^{-1} and maximum with sprouted seed soaking @ 0.05 per cent for 3 hrs at 15 DAT. In case of untreated control, 11.6 per cent damage was recorded. The incidence increased at 30 DAT in all the treatments indicating loss of persistence of the test insecticide. However foliar application at lower dose. i.e. @ 25g a.i. ha^{-1} at 5 DBP was effective as the damage was not increased from 4.3 per cent. It increased in all the treatments and ranged from 6.1 to 11.6 per cent at 30 DAT.

The damage was marginally less (5.8%) in soil application at higher dose i.e. @ 37.5 g a.i. ha^{-1} at 15 DAT compared to lower dose @ 25 g a.i.ha^{-1} (7.2%). Combined treatment (Sprouted seed soaking and drenching) received 6.4 per cent damage whereas it was 10.6 per cent in sprouted seed soaking alone. Similar trend was observed at 30 DAT.

From the perusal of the data of foliar and soil application of imidacloprid at lower and higher concentrations, it is evident that the incidence increased at higher concentration (37.5 g) when applied as foliar spray, while it was severe in case of soil application. This treatment indicated that imidacloprid in rice might have favoured the development of whorl maggot. when applied at higher concentrations. At Warangal, Pattambi and Rajendranagar during *kharif* 1996, *rabi* 1998 and *kharif* 1999 seasons, respectively (Anonymous, 1998 and 1999). The incidence of whorl maggot increased over control at 20, 30 and 40 DAT at all the above mentioned locations. At Rajendranagar during *rabi* 1999 it was 33.5 per cent in control, while it was 42.00 per cent with sprouted seed soaking alone and in combination treatment (sprouted seed soaking + drenching), it was 53.7 per cent (Anonymous, 1999).

Thrips

Minimum damage of 9.2 per cent at 15 DAT and 9.4 per cent at 30 DAT was recorded with combination of sprouted seed soaking along with drenching (Table). Soil application at lower dose (25 g a.i. ha^{-1}) received 10.1 per cent at 15 DAT and increased to 14.2 per cent at higher dose (37.5 g a.i. ha^{-1}) at 30 DAT. Similar trend was observed at Rajendranagar (A.P.)

Table : Effect of different treatments with imidacloprid 200 SL on per cent damage due to whorl maggot and thrips.

Treatment	Time of Treatment	Concentration	Whorl maggot		Thrips	
			15 DAT	30 DAT	15 DAT	30 DAT
Sprouted seed soakig	3hr BS	0.05	10.6 (19.4)	11.6 (20.3)	11.7 (20.7)	11.9 (20.62)
Sprouted seed soaking + drenching	5 DBP	75g	6.4 (14.5)	8.4 (16.6)	9.2 (17.8)	9.4 (18.34)
Soil application	10 DBP	25g	7.2 (15.6)	7.7 (16.2)	10.1 (19.0)	14.1 (23.0)
Soil application	10 DBP	37.5g	5.8 (14.5)	6.1 (14.9)	14.2 (21.5)	16.0 (22.9)
Foliar application	5 DBP	25g	4.3 (12.5)	4.3 (12.6)	13.4 (21.8)	14.6 (22.8)
Foliar application	5 DBP	37.5g	8.4 (17.2)	9.0 (17.7)	10.3 (19.2)	10.5 (19.4)
Carbofuran 3G	5 DBP	1.5kg	8.9 (17.8)	9.7 (18.5)	12.5 (21.1)	12.7 (21.3)
Untreated control	-	-	11.6 (20.3)	11.6 (20.3)	11.0 (19.9)	11.2 (20.0)
S.E±	-	-	2.3	NS	NS	NS
C.D (5%)	-	-	5.7	-	-	-

The values in the parentheses are angular values.
BS - Before sowing; DBP - Days before pulling; DAT - Days after transplanting.
NS - Non significant

(Anonymous, 1999) during *kharif* 1999 where, untreated control plot recorded 41 per cent and in a combination treatment consisting sprouted seed soaking and drenching it was 47.2 per cent.

In case of foliar application it was 13.4 per cent damage at 15 DAT with lower dose and 10.8 per cent at higher dose. Similar trend with both soil and foliar applications was recorded at 30 DAT. Carbofuran 3G also recorded more per cent damage than untreated control plot which received 11.0 and 11.2 per cent damage at 15 and 30 DAT, respectively.

This trend indicated that imidacloprid application in the nursery before pulling did not control thrips in rice. Also the data were found to be statistically non - significant at both 15 and 30 DAT.

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Histological and Histochemical Changes in *Spodoptera litura* (Fab.) Due to The Larval Parasitoid, *Peribaea orbata* (Wied.)

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ABSTRACT

Histological changes like hypertrophy of hypodermis, accumulation of haemocytes around cuticle in wound healing process, hypertrophy of tracheae, formation of respiratory funnel, encapsulation of parasitoid, presence of teratocytes near the parasitoid, degeneration of fat bodies, muscles and spermatogonial cells of testes, vacuolation and loss of cellular identity in salivary gland cells and nervous tissue, cytolysis of malpighian tubules, loosening, clumping and shedding of midgut cells, appearance of extra growth in digestive tract and shrinkage and *melanization of host legs were observed in Spodoptera litura* (Fab.) due to parasitization by a tachinid parasitoid, *Peribaea orbata* (Wied.). The histochemical studies in different tissues of host larvae indicated more or less decrease of proteins, glycogen and lipids due to parasitization

Key Words : *Spodoptera litura F., Peribaea orbata* W., Hypertrophy, Haemocytes, Parasitoid, Encapsulation.

The important role played by endophagous parasitoids in exerting a check on host population was aptly pointed out by Salt (1968). These organisms are highly dangerous to their host as they develop and feed with in the body and eventually kill it. Though they are exposed to several defence reactions of the host, most of them are able to bring histological and histochemical changes in the host in the process of completing its life cycle. Although much work has been done on the pathologies caused by insect parasitoids (Buron *et al.,* 1997 and Hegazi *et al.,* 1999), there remains much more to be accomplished in this interesting field of pathology especially produced by *P. orbata in S. litura.* Studies to assess the histological and histochemical changes occured in the parasitized host were conducted.

MATERIAL AND METHODS

Parasitized and unparasitized fifth instar larvae of *S. litura* cut into three parts i.e. anterior, middle and posterior, were fixed in alcoholic Bouins fixative for 24 hours, washed with Scott's tap water, dehydrated and embedded in paraffin. Each block was transversely sectioned at 6 µm and stained with *Eosin's*, haemotoxylin and Mallory's triple stain for histological studies. For histochemical studies mercury - bromophenol blue for proteins, periodic acid Schiff 's technique for glycogen and sudan black for lipids were used. (Culling, 1981).

RESULTS AND DISCUSSION

Histological Changes

Wound Healing

Wounds are formed on the host cuticle during the process of parasitoid entry or exit (Plate 1 A). Hypertrophy of hypodermis and accumulation of haemocytes (Plate 1 B) near the wounds were observed in *S. litura* after wound was formed. A little later, the sites of haemorrhage appeared as black scars. High percentage of sharply outlined nuclei surrounded by bits of cytoplasm at the site of the wound was observed. Park-Bumjune *et al.* (1995) reported that in response to wound healing process in *S. litura* by artificial puncturing, a cluster of haemocytes gathered around the injured part and adhered completely to each other to clot, which served as a mechanical barrier.

Tracheae

Hypertrophy of tracheal matrix was observed in *S. litura* (Plate 1 C). Benz (1963) reported that increased oxygen consumption destroyed completely the cells of tracheal matrix. *Lixophaga diatraeae* (Tns.) maggots severely damaged the trachea of *Diatraea saccharalis* (F.) with their feeding behaviour (King *et al.*, 1976).

Funnel Formation

After entering the haemocoel, the maggot perforated the trachea near the spiracle of the host resulting irritation of host hypodermal cells and then funnel was formed to enclose the parasitoid maggot. The funnel was wider anteriorly and narrower posteriorly (Plate 1D). The basal part of the funnel was black and brittle and the distal part was thin, membranous and not well melanized in *S. litura*. In *Prodenia eridania* parasitized by a tachinid, *Winthemia quadripustulata*, the funnel was spongy and a ball of pale tumor like tissue. When *W. quadripustulata* parasitized an unsuitable host, the funnel was of hard selerotic shell (Allen, 1925). *In S. litura* haemocytes were arranged in many layers, parallel to the surface of the host. The inner layers were not clear. The basal part of the funnel was covered by hypodermal cells (Plate 1 E). Salt (1968) noted that funnel is the reaction of host to parasitoid.

Encapsulation of Parasitoid

When a single parasitoid of *P. orbata* was present in the fifth larval instar of *S. litura*, sometimes (40-50%) encapsulation was observed. Encapsulation may lead to the death of host as well as that of the parasitoid due to severe pathological effects. In the process of encapsulation the maggot was encircled by haemocytes and ligament was formed around the trunk of parasitoid and then gradually the ligament was melanized and the parasitoid was sealed off (Plate 1 F). Then caudal spiracles and mouth were also closed by thin layer of haemocytes. This might lead to asphyxiation and then to death of the parasitoid. Then the encapuslated parasitoid floated freely in the haemocoel. Salt (1963) reported that in *Galleria mellonella* (L.), the parasitoid, *Nemeritis canescens* (Gravenhorst) was subjected to haemolymph reaction of its host and a melanin ligature was formed around the parasitoid, but sometimes encapsulation was incomplete as a result of the depletion of the host's blood cells. Prevost *et al.* (1990) reported that several mechanisms may co-operate to protect the parasitoid from encapsulation but the pathological reactions by the host haemocytes are considered to be a major manifestation of the immuno suppressive parasitoid effect.

Giant Cells or Teratocytes

More number of giant cells were observed to form in haemolymph of *S. litura* near the parasitoid (Plate II A). Salt (1968) reported that the giant cells also known as teratocytes and the appearance of them was a defensive reaction at the site of chronic inflammation. It was further explained that they rapidly increase in size deplete the haemolymph nutrients and then weaken the host's defence. Hegazi *et al.* (1999) reported that teratocytes might be responsible for depriving the host larva from some biological products necessary for the host development and for successful development of the parasitoid *Microplitis rufiventris* Kok in *Spodotera littoralis* (Boisd.). In *S. litura* giant cells increased considerably in size and rearched a maximum size of 155 microns in diameter. Vacuoled area appeared in the centre of these cells (Plate II B). Buron - I - de *et al.* (1997) reported that in the larvae of the tobacco hornworm, *Manduca sexta* (L.) parasitized by braconid wasp, *Cotesia* sp teratocytes increased enormously in size and number and underwent extensive blebbing.

Fat body

Aggregation of flattened fat cells was observed near the respiratory funnel. Pycnosis, separation of cells and vacuolation of fat cells was also observed (Plate II B). In severe parasitization complete degeneration and disappearance of the fat body and absence of moulting was also observed in *S. litura*. Salt (1963) reported that fat cells which lost their normal structure and present surrounding respiratory funnel were defence in reaction and were gathered around the parasite as a result of the stress created by parasitoids. Benz (1963) reported that fat body is the important centre of metabolism, its destruction in larva prevents moulting and especially metamorphosis and may eventually lead to death. King *et al.* (1976) reported that in severe cases, all the fat material of sugarcane borer, *Diatraea saccharalis* (F.) was consumed by its tachinid parsitoid, *Lixophaga diatraeae* (Tns.).

Muscles

In muscles striations disappeared, epimysium was separated, hypertrophy and degeneration were observed (Plate II C). Pantel (1910) observed degeneration of muscles with eventual liquifaction of the muscular contents in caterpillers, *Spintherops* sp. and *Vanessa* sp. when parasitized by tachinid maggots, *Plagia* (Cyrtophlebia) *ruricola* and *Sturmia pupiphaga*. King *et al.* (1976) reported that muscle tissue was scraped from the body wall of host by the parasitoid maggot, *L. diatraeae*.

Testes

Shrivelling of the testes and degeneration of their muscles was observed. Spermatogonial cells were dispersed in the cavity of testes. In severe cases of parasitism degeneration of spermatogonial cells (Plate II D) was also observed. Junnikkala (1966) reported that atrophy and inhibited development occured in the testes of *Pieris rapae* (L.) parasitized by *Apanteles glomeratus* (L.). In *S. litura* degeneration of spermatogonial cells might lead to inhibition of spermatogenesis totally or partially.

Salivary Glands

Vacuolation of gland cells and cytolysis of gland duct cells was observed (Plate II E.). Pantel (1910) reported that the salivary glands were soon ceased and completely degenerated in *Chondrostega vandalicia* parasitized by an unidentified tachinid larva. These changes might effect the production and transport of saliva. It is observed that the ejection of saliva was negligible to external stimuli like pinprick in parasitized host when compared to unparasitized.

Nerve Cord and Nerve Ganglion

Vacuolation, clumping, complete loss of cellular identity and degeneration of the cells of nerve cord and ganglion (Plate II F) were noted. The destruction of the ganglion due to infection of microorganisms was reported to effect locomotion, respiration, circulation and digestion (Benz, 1963). In *S. litura* destruction of nerve cord and ganglia might lead to general paralysis.

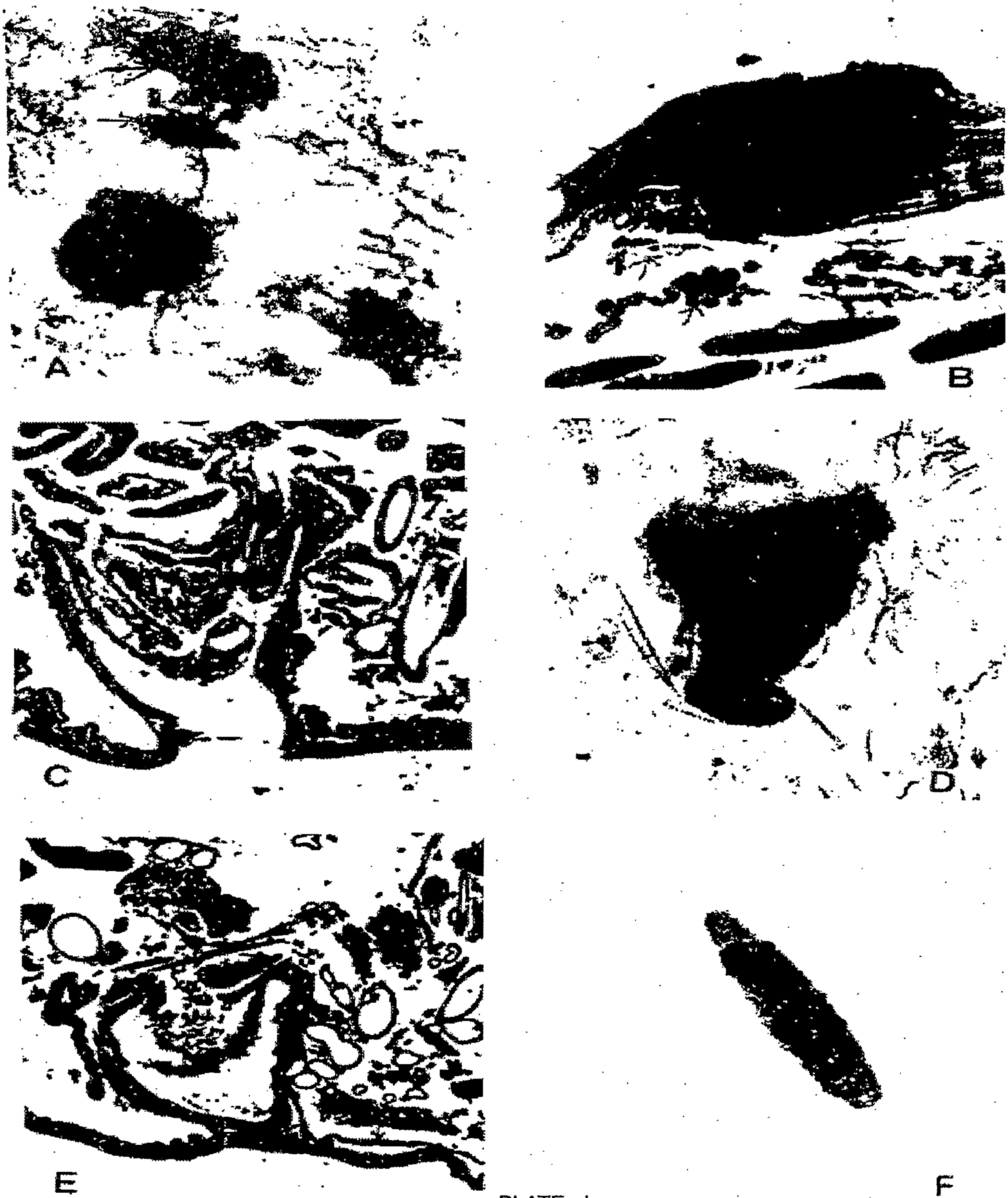

PLATE - I

istological Changes in Parasitized *S. litura*

. Entry and Exit holes in cuticle
. Hypertrophy of tracheal matrix
. Hypodermal covering of respiratory funnel

B. Wound healing of cuticle showing accumulation of haemocyt
D. Respiratory Funnel
F. Encapsulated maggot

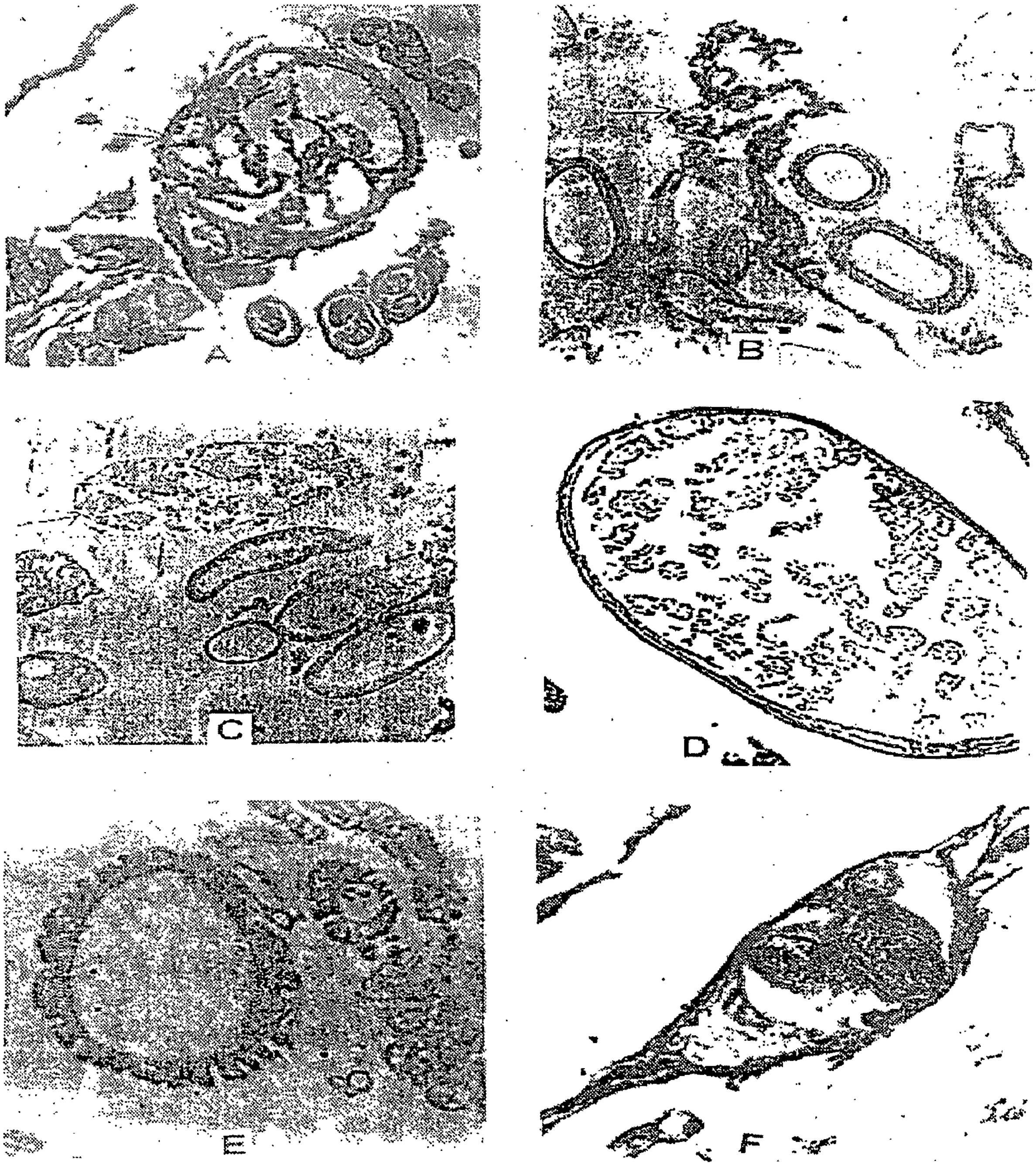

PLATE - II

Histological Changes in Parasitized *S. litura*

A. Giant cell or teratocyte	B. Cytolysis of fat body
C. Degeneration of muscle	D. Degeneration of speramatogonial cells
E. Cytolysis of salivary gland duct cells	F. Degenerated cells of ganglion

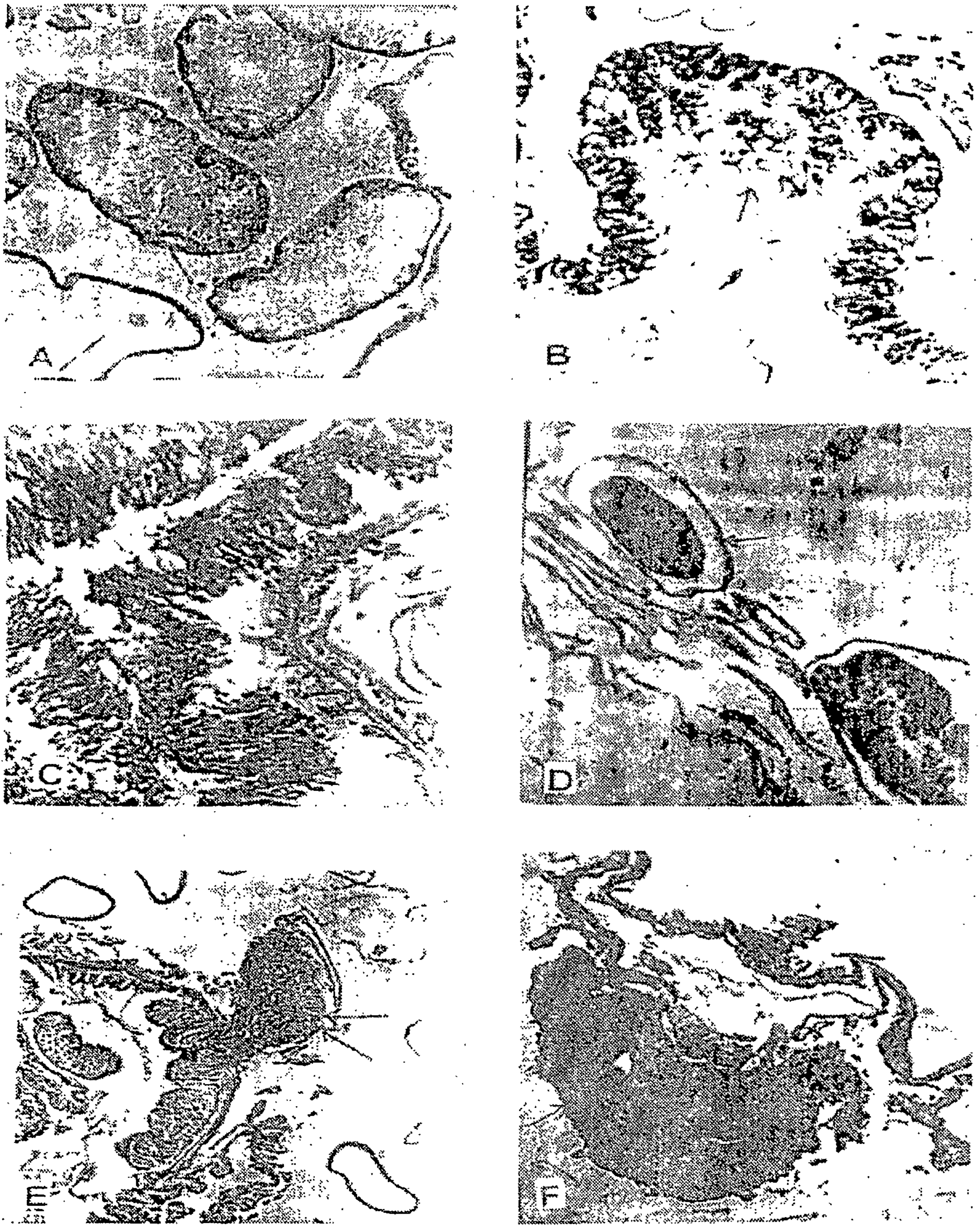

PLATE - III

Histological Changes in Parasitized *S. litura*
A. Cytolysis and loss of cell boundaries in malpighian tubule
B. Shedding of cells into lumen of digestive tract
C. Lysis of columnar cells in gut wall
D. Encapsualtion of necrotic bodies in digestive tract
E. Extra growth in digestive tract
F. Leg showing disappearance of fat cells and presence of melanization.

Table 1 : Histochemical changes by relative staining intensities of *S. litura.*

Parameter	Up or P	Cuticle	Muscles	Fat Body	Malpighian tubules	Testes	Dig. tract	Salivary gland duct	Nerve cord and Nerve ganglion
Proteins	UP	++	+++	+++	++	++	+++	++	++
	P	+	+	+	+	+	++	+	+
Glycogen	Up	++	+++	+++	++	++	+++	++	++
	P	-	+	+	+	+	++	+	+
Lipids	UP	*	*	+++	++	*	+++	++	++
	P	*	*	-	+	*	-	++	+

* Not observed UP - Un Parasitized
- Absent P - Parasitized

The parasitized host moved slowly and gave less response to external stimuli (eg. pinprick) when compared to unparasitized host.

Malpighian Tubules

These are the main excretory organs in insects. Extensive cytolysis, pycnosis of nucleus, loss of cell boundaries and cilia in striated border of malpighian tubules were observed. (Plate III A). Benz (1963) reported that malpighian tubules were eventually destroyed in pathological conditions. He emphasized that damage of malpighian tubules might be the result of extra stress caused in eliminating the excreta of the parasitoid in the haemolymph.

Digestive Tract

Loosening of midgut cells from one another and from basement membrane and shedding of cells into the lumen of gut were observed (Plate III B). The gut was separated into pieces due to loosening of connective tissue layer and lysis of columnar cells in gut wall (Plate III C), encapsulation of necrotic bodies (Plate III D) and some unusual extra growth (Plate III E) were noted. These observations are in accordance with the observations of Pantel (1910) in digestive tract of *Acronycta aceris* parasitized by tachinid, *Compsiluria concinnata.* King *et al.* (1976) reported that maggots of *Lixophaga diatraeae* (Tns.) severely damaged and ruptured the gut of *Diatraeae saccharalis* (F.) with their feeding activity.

Leg

The leg of the host nearer to the lodging of the parasitoid was damaged. Shrinkage, melanization and degeneration of fat cells were observed (Plate III F) in the legs of parasitized *S. litura.* Depletion of nutrients in fat body and their damage by parasitoid in any organ of host may lead to shrinkage, paralysis and finally death (Benz, 1963).

Histochemical Changes

The histochemical changes occured in the tissues of parasitized host are presented in table 1.

Proteins

Due to parasitization, complete depletion of proteins was observed in muscles and fat body. More or less all tissues lost their protein content. Iwantsch and Smilowitz (1976) reported that fat body cells of *Trichoplusia ni* (Hubner) remained small and devoid of glycogen due to parasitization by *Hyposoter exiguae* (Viereck).

Glycogen

Glycogen depletion was observed in all the tissues of *S. litura* especially in fat body and muscles. Glycogen is stored in the fat body and to some extent in muscles and other tissues. Depletion of glycogen occured in the fat body of *Heliothis virescens* (F.) parasitized by *Cardiochiles nigriceps* (Viereck) (Vinson and Barras 1970). Iwantsch and Smilowitz (1976) reported that fat body cells of *Trichoplusia ni* (Hubner) remained small and devoid of glycogen due to parasitization by *Hyposoter exiguae* (Viereck).

Total lipids

Total depletion of lipids was observed in the fat body and digestive tract of *S. litura.* In other tissues like malpighian tubules, nerve cord and ganglion depletion of lipids was noted, but no change in the lipid content of salivary gland duct was noted. Vinson and Barras (1970) reported that accumulation of lipids in the fat body of host was either prevented or retared.

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Efficacy of Botanical Mixtures Against Bhendi Shoot and Fruit Borer, *Earias Vitella* (Fab.)

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ABSTRACT

A laboratory and field investigation was carried out to know the joint toxicity of neem with other botanical extracts. In the laboratory studies, neem (N) (*Azadirachta indica*) in combination with other botanical extracts *viz.*, sweet-flag (s) (*Acorus calamus*) and pungam (P) (*Pongamia glabra*) at 1:1:1 (NSP I), 2:1:1 (NSP II) and 3:1:1 (NSP III) (v/v) ratios was evaluated on oviposition and egg mortality of *E. vitella*. Among the treatments, botanical mixture i.e. NSP (I) @ 0.3% recorded improved efficacy over the application of neem alone in deterring the moths from oviposition and it was the best among the treatments in inhibition of egg hatching (66.78%). In the field evaluation, among the botanicals tested NSP (I) @ 0.42% was found superior in containing the damage caused by the shoot and fruit borer, which is comparable with endosulfan @ 0.07%. The highest yield of bhendi fruits was recorded in endosulfan (14.24 t/ha) followed by NSP (I) (13.27 t/ha) treated plots. The order of efficacy in reducing the shoot and fruit borer infestation in bhendi was endosulfan @ 0.07% > NSP (I) @ 0.42 > NSP (I)@ 0.3% > Neem @ 0.3% > NSKE 5% > Neem Oil 3% > NSP (I) @ 0.18% ≥ Neem @ 0.18%.

Key words : Neem, Sweet - flag, Pungam, *E. vitella*, Oviposition, Ovicidal action.

Bhendi crop is infested by over 72 species of insects, among which the shoot and fruit borer was considered as important. Caterpillars of *E. vitella* bore into tender shoots, buds, flowers and developing fruits causing a peak of 8.5 and 41.25 per cent shoot and fruit damage, respectively (Abshek Shukla *et al.*, 1997). Of late, non - judicious use of synthetic pesticides led to problems like resistance to chemicals, resurgence of sucking pests, residues in the soil and agricultural produce and risks to human and animal health, besides environmental pollution (Mahapatro and Gupta, 1998). Botanical pesticides are the best alternative to manage the pest below the economic threshold level (ETL) and provide security to mankind from the hazardous residues of pesticides. Among the phytochemical sources, neem has been used since time immemorial by Indian farmers and its pest controlling properties were scientifically documented in laboratory and field tests. Ovipositional deterrency (Sojitra and Patel, 1992) and ovicidal action (Gujar and Mehotra, 1993) of neem against insect pests was well documented. As well anti - ovipositional and ovicidal activity of pungam (Shelke *et al.*, 1987) and sweet - flag (Nair and Thomas, 2000) was well documented. The field efficacy of extracts of neem (Singh *et al.*, 1988) sweet - flag (Jeyarajan Nelson, 1996) and pungam (Shukla *et al.*, 1996) against bhendi shoot and fruit borer was also well established. But little information is available on their combined action, hence the present study was attempted to know the efficacy of botanical mixtures at various proportions in comparison with the individual treatment of neem.

MATERIAL AND METHODS

Extraction and Formulation

Seed kernels of neem and pungam and rhizomes of sweet - flag were ground to fine powder and their extracts were obtained in methanol by cold extraction. The extracts were made free of methanol in distillation unit at 50°c under reduced pressure. The following botanical mixtures were prepared.

1. Neem + Sweet-flag + Pungam in 1:1:1 (v/v) (NSP I),
2. Neem + Sweet-flag + Pungam in 2:1:1 (v/v) (NSP II) and
3. Neem + Sweet-flag + Pungam in 3:1:1 (v/v) (NSP III) and formulated to 60 EC using an organic solvent (Cyclohexanone) and an emulsifier (Unitox ®)

Laboratory Experiments

Ovipositional Deterrency

Thirty - days - old excised shoot tips along with fruits were dipped in test concentrations for 30 seconds and shade dried, and planted in disposable cups. Then they were arranged at equi - distance in a circular fashion in insect cage of 55 x 55 x 70 cm size. Five pairs of adults were confined in the cage for 24 h and allowed to oviposit on the treated twigs. Ten per cent honey was provided as food for adults. The number of eggs laid on each twig was recorded and per cent oviposition was calculated. Relative ovipositional preference was estimated (Mehta and Saxena, 1970) using Neem 60EC treatment as standard check.

$$\text{Relative ovipositional preference} = \frac{\text{No. of eggs laid in treatment} - \text{No. of eggs laid in standard check}}{\text{No. of eggs laid in treatment} + \text{No. of eggs laid in standard check}}$$

Ovicidal Action

From the mass culture thirty one - day - old eggs were taken and carefully transferred into muslin cloth with fine camel hairbrush. The eggs were sprayed with different test concentrations used in the first experiment under Potter's tower at 24 cm Hg pressure and shade dried. The treated eggs were transferred to the petridishes and covered with moist muslin cloth to maintain suitable relative humidity and the treatment setup was kept at a temperature of 27 ± 1°c for incubation. Each treatment was replicated thrice. The eggs treated with solvent served as control. The matured blackhead stage eggs were transferred to fresh petridishes and allowed to hatch. The eggs, which did not turn black, were considered as dead ones. The per cent un-hatched eggs were recorded (Bhanukiran and Panwar, 2000).

Field Experiment

The field trial (bhendi : var. Arka Anamica) was conducted at farmer's holdings (Vikkiramangalam, Madurai dist.) in a randomized block design during summer 2001 with nine treatments including control and replicated thrice. Three rounds of sprays were given at 15 days interval from 45 days after sowing and the data were recorded at regular intervals.

Pest assessment

The extent of damage caused by shoot and fruit borer was recorded at 7 DAT by observing the total number of healthy and infested fruits from 10 randomly selected plants per plot (Hanumantha Rao and Arjuna Rao, 1996) and the infestation was computed as percentage. The fruits were harvested at two days interval and the yield of both infested and healthy fruits was recorded and expressed as percentage.

Table 1 : Ovipositional deterrency and ovicidal action of botanical mixtures on *E. vitella*

Treatment	Conc. (%)	Ovipositional deterrecy test			Ovicidal action test
		Eggs laid (No. / day)	Ovipostion (%)	Relative Ovipostion Preference	Mortality (%)
Neem 60 EC	0.18	46.66 (6.83)^{d}	12.57	0.00	16.83 (24.05)^{c}
Neem 60 EC	0.3	36.00 (5.99)^{bc}	9.70	0.00	45.09 (42.17)^{b}
NSP (I) 60 EC	0.18	37.33 (6.10)^{c}	10.05	-11.10	24.10 (29.39)^{c}
NSP (I) 60 EC	0.3	29.00 (5.38)^{a}	7.81	-10.76	66.78 (55.01)^{a}
NSP (II) 60 EC	0.18	40.00 (6.32)^{c}	10.77	-7.68	20.45 (26.84)^{c}
NSP (II) 60 EC	0. 3	32.66 (5.71)^{ab}	8.80	-4.86	55.90 (48.40)^{b}
NSP (III) 60 EC	0.18	48.00 (6.92)^{d}	12.93	+ 1.41	17.01 (24.29)^{c}
NSP (III) 60 EC	0. 3	38.33 (6.18)^{c}	10.32	+3.13	51.03 (45.59)^{b}
Control	-	63.25 (7.98)^{c}	17.04	-	-

Figures in parentheses are square root transformed values ($\sqrt{x}$). Where, x is number of eggs laid per adult
Means in a column followed by same letter (S) are not significantly different by ($p = 0.05$) DMRT.

Statistical Analysis

The per cent egg mortality was arrived by using Abbot's formula. The per cent reduction over control in field population was arrived by using Henderson and Tilton (1995) formula. The mean values of treatments were separated by Duncan's multiple range test (DMRT).

RESULTS AND DISCUSSION

The data from Table 1 suggest that NSP @ 0.3% deterred *E.vitella* adults significantly from oviposition. Among the treatments, NSP 1 @ 0.3% recorded a minimum of 29.0 eggs (7.81%) laid by *E. vitella* in a day as compared to a maximum of 63.25 (17.04%) eggs recorded in the control. Compared to neem (standard check), the relative ovipositional preference was less in all the treatments, except in NSP (III) treatment.

Neem seed kernel extracts and pure compounds (Isman, 1996) sweet - flag extracts (Jeyarajan Nelson, 1996) and pungam seed extracts (Sharma and Bhatnagar, 1993) were reported for ovipositional deterrent effects on many crop pests. Botanical mixtures : NSP (I) and NSP (II) had recorded fewer number of eggs laid by *E. vitella* due to higher anti-ovipositional effect than the treatment with neem alone. Increased ovipositional deterrent effect was expected since all the three botanicals elicit the biological effect individually. But the combinations worked well at 1:1:1 or 2:1:1 level, while NSP (III) registered a poor anti - ovipositional effect than the treatment with neem alone.

Table 2 : Efficacy of botanical mixtures against shoot and fruit borer on bhendi

			1 SPRAY			2 SPRAY			3 SPRAY	
Treatment	Conc. (%)	PTC	7 DAS	Per cent Reduction	PTC	7 DAS	Per cent Reduction	PTC	7 DAS	Per cent Reduction
Neem 60 EC	0.18	27.75	22.98	28.10 (32.00)^{g}	23.25	21.27	22.95 (28.62)^{h}	24.42	22.66	21.86 (27.87)^{g}
	0.3	23.20	14.03	47.50 (43.56)^{d}	17.85	11.98	43.46 (41.24)^{d}	16.50	11.44	41.60 (40.16)^{d}
NSP (I) 60 EC	0.18	26.45	20.01	34.33 (35.86)^{f}	19.20	16.75	26.53 (31.00)^{g}	20.25	17.42	27.56 (31.66)^{f}
	0.3	31.20	16.35	54.50 (47.58)^{c}	17.85	11.05	47.86 (43.77)^{c}	15.50	10.20	44.56 (41.87)^{c}
	0.42	28.75	12.47	62.33 (52.14)^{b}	16.25	7.99	58.56 (49.93)^{b}	14.75	6.43	63.26 (52.73)^{b}
Neem oil	3.0	30.50	21.72	38.16 (38.15)^{e}	21.85	17.50	32.56 (34.79)^{f}	20.40	17.45	27.96 (31.92)^{f}
NSKE	5.0	32.00	19.78	46.33 (42.89)^{d}	22.50	16.75	37.30 (37.64)^{e}	19.20	14.73	35.36 (36.49)^{e}
Endosulfan 35 EC	0.07	29.25	8.65	74.33 (59.57)^{a}	15.75	5.43	70.93 (57.38)^{a}	14.83	5.72	67.50 (55.24)^{a}
Control	-	28.95	33.33	-	36.80	43.66	-	40.85	48.50	-

PTC - Pre - treatment count (Number of damaged fruits / 10 plants). DAS - Days after spraying. Mean of three replications. Figures in parentheses are arcsine transformed values. Where, P is per cent reduction over control. Means in a column followed by same letter(s) are not significantly different by ($p = 0.05$) DMRT.

In this experiment all the treatments showed significantly high mortality of eggs as compared to control (Table 1). NSP (I) @ 0.3% (66.78%) was the best among the treatments that inhibited the egg hatching followed by NSP (II), NSP (III) and neem @ 0.3% which inhibited the egg hatching to an extent of 55.90, 51.03 and 45.09 per cent, respectively. In all the treatments at lower concentrations, ovicidal action was poor. Ovicidal action of botanical mixtures was higher than the treatment with neem alone.

Ovicidal action of neem compounds (Bhanukiran and Panwar, 2000), sweet - flag extracts (Jeyarajan Nelson, 1996) and pungam extracts (Bhatnagar *et al.*, 1995) was well established. In the present study, neem in combination with other botanicals caused a high rate of mortality to the eggs of *E. vitella*. This is possible because of increased toxicity of the botanicals in combination.

In the field investigation among the treatments, the NSP (I) @ 0.42% recorded 62.33 per cent reduction in the incidence of *E. vitella* at 7 DAT and it was 28.10 to 47.5 per cent in neem at 0.18 and 0.3%, respectively. In addition the newly formed fruits were protected from the pest.

During the second application, on 15th day after first spray, fruit damage was 15.75 to 36.80 damaged fruits / 10 plants. Among the various treatments, endosulfan @ 0.07% recorded 70.93 per cent reduction in the damage at 7 DAT, while it was 58.56 per cent in NSP (I)

Table 3 : Efficacy of botanical mixtures on the fruit yield of bhendi

Treatment	Conc. (%)	Yield (t/ ha)	Yield (t /ha) damage fruits	Yield loss (%)	Yield increase over control (%)
Neem 60 EC	0.18	10.24 (3.20)^{f}	3.32 (1.82)^{g}	24.48	16.09
	0.3	11.83 (3.43)^{d}	2.67 (1.63)^{d}	18.41	34.12
NSP (I) 60 EC	0.18	10.41 (3.22)^{f}	3.12 (1.76)^{fg}	23.05	18.02
	0.3	12.24 (3.49)^{c}	2.26 (1.48)^{c}	15.58	38.77
	0.42	13.27 (3.64)^{b}	1.94 (1.39)^{b}	12.75	50.45
Neem oil	0.3	11.04 (3.32)^{e}	2.91 (1.76)^{ef}	20.86	25.17
NSKE	5.0	11.78 (3.43)^{d}	2.73 (1.65)^{de}	18.81	33.56
Ensosulfan 35 EC	0. 05	14.24 (3.77)^{a}	1.43 (1.96)^{a}	9.12	61.45
Control	-	8.82 (2.97)^{g}	4.26 (2.06)^{h}	32.56	-

Mean of three replications. Figures in parentheses are square root transformed values (√x). where, x is ield in tons. Means in a column followed by same letter(s) are not significantly different by ($p=0.05$) DMRT.

@ 0.42% treated plots. All the treatments were significantly different from each other.

Before the third spray, the fruit damage ranged from 14.75 to 40.85 damaged fruits / 10 plants. Among the botanicals tested, the NSP (I) @ 0.42% recorded a maximum reduction of 63.26 per cent in the fruit damage but it was significantly lower than that in endosulfan @ 0.07% (67.50%) spray. The order of efficacy in reducing the shoot and fruit borer infestation in bhendi was endosulfan @ 0.07% > NSP (I) @ 0.42 > NSP (I) @ 0.3% > Neem @ 0.3% > NSKE 5% > Neem Oil 3% > NSP (I) @ 0.18% > Neem @ 0.18% (Table 2).

The yield of bhendi fruits was high in endosulfan @ 0.07% treated plots (14.24 t/ha), which was closely followed by NSP @ 0.42% (13.27 t/ha). The fruit damage by *E. vitella* was less in endosulfan 35 EC @ 0.07% treated plots followed by NSP (I) @ 0.42 % and other botanical treatments. This could be attributed due to various reasons : primarily, deterring the moths from oviposition, inhibition of egg hatching, contact toxicity and antifeedant properties which were superior in botanical combinations than neem alone, as evidenced in the laboratory findings of the present investigation. However, endosulfan treated plots recorded a higher yield of 14.24 t/ha followed by NSP (I) @ 0.42% (13.27 t/ha) as against 11.83 t/ha in neem @ 0.3% which are significantly superior than untreated control. This is in line with the findings of Ganeshan *et al.* (1995) and Jeyarajan Nelson (1996) who reported the improved efficacy of neem when combined with other botanicals against insect pests.

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Effect of Temperature during Centrifugation on the Efficacy of Nuclear Polyhedrosis Virus

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ABSTRACT

A laboratory experiment was conducted to study the efficacy of Nuclear polyhedrosis virus purified at different temperatures in deep freeze centrifuge and at different centrifugation speeds in ordinary centrifuge. The results showed that there was no significant difference between the POB's recovered at different centrifugation speeds *viz.*, 2000 rpm to 10000 rpm though there was increase in temperature from 31.5⁰C to 38.5⁰C and there was no loss of virulence ofHa NPV. LT_{50} values varied from 120.73 h to 126.75 h. There was no effect on recovery and virulence of POB's with the increase in temperature from - 5⁰C to 25⁰C. During centrifugation in deep freeze centrifuge, LT_{50} values varied from 117.53 h to 126.96 h. The rise in temperature in ordinary centrifuge during centrifugation (10000 rpm) did not have any deleterious effect on virulence of POB's which was below the critical temperature.

Key Words : Temperature, Centrifugation, NPV, POBs, RPM, *H.armigera*

Nuclear polyhedrosis virus (NPV) of *Helicoverpa armigera* (Hubner) has great potential to control this notorious pest and it has received a great deal of attention owing to it's advantages like host specificity, high virulence, economic feasibility, environmental safety and compatibility with other methods of pest control. However it has been documented that temperature has considerable effect on inactivation of the virus during storage (Shapiro and Ignoffo, 1969; Kaushik and chaudary 1993). There are no reports on the effect of increased temperature on the efficacy of virus during centrifugation. Present study was conducted to know the effect of temperature at different centrifugation speeds and effect of different temperatures on the efficacy of the virus.

MATERIAL AND METHODS

Mass multiplication of virus was done by using field collected *Heliothis* larvae as per the procedure given by Rabindra and Subramanian (1974). Diseased larvae were allowed to putrify in distilled water for seven days and the supernatant was decanted. Diseased larvae were ground in a blender, sediment containing POB's was collected and suspended in distilled water which was centrifuged for one minute at 500 rpm in order to remove larval debris. Supernatant containing POB's was taken and it was subjected to different centrifugation speeds in ordinary centrifuge at 2000 rpm, 4000 rpm, 6000 rpm, 8000 rpm and 10,000 rpm to know the recovery and efficacy of POB's. Rise in temperature at different centrifugation speeds was recorded by dipping the thermometer in NPV suspension immediately after centrifugation. After recording temperature, the pellet was re-suspended in distilled water and again centrifuged at the respective speeds to obtain pure POB's which was used for further bioassay studies.

In another experiment, NPV suspension was centrifuged at 6000 rpm for 15 minutes in deep freeze centrifuge at different temperatures *viz.*, -5, 5, 10, 15, 20 and 25⁰C to assess the thermostability of virus particles. The pellet obtained at different temperatures was used for further bioassay studies after counting the POB's per ml.

Before conducting the bioassay test the POB count was estimated using "Neubaur's haemocytometer". All NPV solutions centrifuged at different centrifugation speeds brought to the same concentration i.e. minimum concentration of 10^6 POB per ml which is required to cause infection in order to test its efficacy. This standardization was done through serial dilution.

The first experiment on testing the efficacy of NPV centrifuged at different speeds comprised of six treatments replicated four times. For each treatment 80 second instar larvae were used. In each replication 20 larvae were treated. Bengalgram leaves previously washed in distilled water were dipped in virus suspension of 10^6 POB per ml of the respective treatment i.e. centrifuged at different speeds were fed to neonate larvae. On subsequent days larvae were provided with fresh leaves till the death or completion of larval period. The observations on mortality of larvae due to NPV was expressed into per cent mortality using the following formula and LT_{50} was calculated by probit analysis (Finney, 1971).

$$\text{Per cent mortality} : \frac{\text{Number of larvae dead due to NPV}}{\text{Total Number treated}} \times 100$$

In the second experiment, to test the thermostability of the NPV, NPV suspension was purified by centrifuging in deep freeze centrifuge at 6000 rpm for 15 minutes by maintaining different temperatures *viz.*, -5, 0, 5, 10, 15, 20, 25°C. This experiment comprised of eight treatments replicated three times. For each treatment 60 larvae were used. In each replication 20 larvae were treated. Bioassay was conducted by leaf dip method. The detailed procedure followed was similar to that of the earlier experiment. Here to find out the effect of temperature, all the NPV suspensions centrifuged at different temperatures in deep freeze centrifuge were compared with NPV suspension purified at room temperature in ordinary temperature (control) by conducting bioassay tests. The observations on mortality of larvae due to NPV was expressed into per cent mortality using the formula and LT_{50} was calculated by probit analysis (Finney, 1971).

RESULTS AND DISCUSSION

Recovery of HaNPV at different revolutions

The total of POB's recovered at different centrifugation speeds from 25 larvae ranged from 68.37 x 10^9 POB's to 70.32 x 10^9 POB's. The highest number of POB's were recovered at 10,000 rpm (70.32 x 10^9). The highest number of POB's recovered or obtained per larva at 10,000 rpm was 2.813 x 10^9.

The number of POB's recovered per ml at different centrifugation speeds ranged from 4.55 x 10^9 POB's per ml to 4.68 x 10^9 POB'S per ml The highest number of 4.68 x 10^9 POB's per ml was recorded at 10,000 rpm. The results (Table 1) indicated that there was no significant increase in POB's count with the increase in rpm though there was slight increase in POB's count at higher rpm but there was increase in temperature with the increase in rpm.

Mortality response of *H. armigera* to HaNPV purified at different revolutions per minute (rpm).

To know the effect of increase in temperature recorded during centrifugation on the virulence of HaNPV suspension purified at different rates of rpm *viz.*, 2,000, 2,500, 4,000, 6,000, 8,000 and 10,000 rpm laboratory bioassay was conducted against 2nd instar larvae of *H. armigera* at the dosage of 10^6 POB's per ml. The results of the experiment are indicated in the Table 2.

The results indicated that though there was decrease in the mortality with the increase in rpm, all the treatments were at par with each other. The mortality on the 10th day indicated that there was no effect of increase in rpm (from 2000 to 10,000) on the virulence of the NPV. The probit analysis showed that LT_{50} values ranged from 120.73 h (2,000 rpm) to 126.75 h at 10,000 rpm as against 121.97 h at 2,500 rpm.

Recovery of HaNPV at different temperatures during centrifugation

Table 1 : Recovery of HaNPV at different revolutions per minute (rpm)

Sl. No.	Treatments	Number of HaNPV infected IV instar larvae	Temperature recorded inside the container(^{0}C)	Total number of POB's obtained	Total quantity of POB's recovered (LE)*	POB's per larva	Total Number of POB's per ml of pure virus suspension	POB's present per ml of pure virus suspension (LE)
1	2000 rpm	25	31.5	68.37×10^9	11.39	2.735×10^9	4.55×10^9	0.760 a
2	4000 rpm	25	35.0	69.92×10^9	11.65	2.797×10^9	4.66×10^9	0.776 a
3	6000 rpm	25	36.0	70.20×10^9	11.70	2.808×10^9	4.68×10^9	0.780 a
4	8000 rpm	25	37.0	70.27×10^9	11.71	2.811×10^9	4.68×10^9	0.781 a
5	10000 rpm	25	38.5	70.32×10^9	11.72	2.813×10^9	4.68×10^9	0.780 a
6	2500 rpm	25	32.0	68.97×10^9	11.49	2.759×10^9	4.59×10^9	0.764 a

In a column, means followed by the same alphabet do not differ significantly (P = 0.05) by DMRT

1 LE = 6×10^9 POB's

HaNPV suspension was centrifuged in deep freeze centrifuge by maintaining different temperatures varied from -5^{0}C to 25^{0}C to know the effect of temperature during centrifugation on recovery and virulence of POB's. The total number of POB's recovered at different temperatures ranged from 70.25×10^9 (-5^{0}C) to 70.82×10^9 (25^{0}C). In terms of larval equivalent it ranged from 11.70 to 11.80. There was no significant difference among the treatments. The results indicated that there was no effect of increase in temperature from -5^{0}C to 25^{0}C on the recovery of POB's during centrifugation.

Mortality response of *H. armigera* to HaNPV purified at different temperature

Laboratory bioassay was conducted to know the efficacy of HaNPV purified at different temperatures in deep freeze centrifuge. These results indicated that there was no effect of increase in temperature from -5^{0}C to 25^{0}C on the virulence of POB's. The probit analysis showed that LT_{50} values ranged from 117.53 h to 126.96 h.

Total quantity of POB's recovered and rise in temperature at different revolutions per minute was compared with the POB's recovered at 2,500 rpm (recommended). The efficacy of POB's purified at different rates of rpm was evaluated by conducting bioassay tests. The present study revealed that there was no significant difference in total quantity of POB's obtained at different rates of rpm, as there was no significant difference in POB's present per ml of pure virus suspension purified at different rpms. The bioassay studies showed that there was no loss in virulence of POB's purified by changing the speed from 2000 to 10,000 rpm and there was no effect of increased temperature from 31.5^0 to 38.5^{0}C due to increase in rpm.

Similarly in the second study HaNPV was purified at different temperatures i.e. -5^{0}C to 25^{0}C. The efficacy of different treatments was compared by counting the POB's and by conducting the bioassay tests using the HaNPV purified in deep freeze centrifuge by maintaining different temperatures. This study also revealed that there was no effect of rise in temperature from -5^{0}C to 25^{0}C on the POB's count and virulence. No loss in virulence of POB's with rise in temperature is due to stability of virus particles to higher temperature i.e. even upto 80^{0}C. The results of the above two studies are supported by Gudauskas and Cannerday (1968) who found that the thermal inactivation point of NPV of *Helicoverpa* to be 75 to 80^0 for 10 minutes and that of *Tricoplusia ni* to be 82 to 88^{0}C for 10 minutes. Yendol and Hamlen (1973) reported that NPV in intact inclusion bodies withstand freezing and prolonged normal field temperature.

The cumulative mortality values in the above two studies ranged from 83.33 to 97.50 per cent, which is in conformity with the results of Kaushik and chaudhary (1993) who had recorded cumulative mortality of 88.4 per cent

Table 2 : Mortality response of *Helicoverpa armigera* to HaNPV purified at different revolutions per minute (rpm)

Sl. No.	Treatments	Percent larval mortality at different days after inoculation			Time mortality response				
						Fiducial limits (h)		Chisquare	
		5	7	10	LT_{50}(h)	Lower	Upper	value	Slope
1	2000 rpm	52.50 a (46.44)	81.25 a (64.58)	97.50 a (82.02)	120.73	115.09	125.78	6.51	7.92
2	4000 rpm	46.25 b (43.12)	78.75 ab (62.57)	95.00 a (78.16)	124.21	188.31	129.53	4.12	7.43
3	6000 rpm	45.00 b (42.26)	77.50 ab (61.66)	93.75 a (75.18)	125.75	119.92	131.07	4.54	7.48
4	8000 rpm	46.25 b (42.82)	76.25 ab (61.16)	91.25 a (72.74)	125.01	118.31	131.03	2.24	6.39
5	10000 rpm	45.00 b (42.10)	75.00 b (60.15)	90.00 a (71.26)	126.75	119.00	133.68	2.21	5.43
6	2500 rpm	51.25 a (45.39)	80.00 a (64.15)	96.25 a (78.72)	121.97	115.77	130.46	7.22	5.86
	SEm +	1.05	1.06	3.72					
	C.D. at 5%	3.13	3.15	NS					
	C.V. (%)	4.91	6.77	8.11					

* Figures in parentheses are arcsine transformed values

- In a column, means followed by the same alphabet do not differ significantly (P = 0.05) by DMRT
- HaNPV was evaluated at a dose of 10^6 POB's ml against second instar

when HaNPV was applied at the dose of 10^7 POB's / ml. Manjula and Padmavathamma (1999) observed 89.33 per cent mortality in 2nd instar *H. armigera* @ 10^7 POB's / ml. Slightly higher mortality values ranging from 90.00 to 97.50 per cent were recorded in the present study and this may be due to strain variation.

The probit analysis showed that the LT_{50} values ranged from 117.53 to 126.96 h which were in conformity with the results of Gopali (1998) who recorded LT_{50} of 124.72 h.

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Effect of Seed Processing on Germination and Vigour in Marigold Seeds (*Tagetes* spp).

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ABSTRACT

Results of an experiment conducted at the Division of Seed Science and Technology, Indian Agricultural Research Institute, New Delhi during 1998 - 1999 season indicated that the germination and vigour of seeds increased by seed processing in marigold (*Tagets ssp*). Germination was improved to a significant extent after seed cleaning with air velocity at 10 ms^{-1} and drying seeds to ~ 8% moisture content. In African marigold, seed cleaning and up-gradation had pronounced effect on germination where as French marigold had greater influence on germination through mechanical drying.

Key Words : Seed Processing, Germination, Vigour.

Marigolds *(Tagetes* spp*).* belongs to the family Asteraceae and are native to South and Central America especially Mexico. Marigold is commercially grown for its flowers in India and Central America. In recent years, cultivation of marigold has increased through out the world, on account of its various commercial uses and also due to its short duration nature. Since, it is not season bound in the Indian plains, it can be grown throughout the year. Marigold is mainly propagated through seeds and the problem associated with the most flower seeds is their poor storability. The seed yield from a well - managed marigold crop will be around 33 kg $acre^{-1}$. The seed recovery will be around 30 per cent which depends on the date of planting of the crop. The requirement for marigold seeds in India vary from 48 - 54 metric tonnes depending on the seed viability and physical purity. But 80 per cent of the seed requirement is met from seeds of previous season collected and stored by the farmers and remaining 20 per cent of the seed is purchased by farmers from private seed firms and Government agencies. Seeds of previous season crop may have a germination of 30 - 40 per cent with poor seedling vigour depending on the weather during the crop growth and seed development as well as method of seed storage. In marigold, the seed dormancy persists for a period of about six months (Ramakrishna *et al.,* 1970). However, dormant seeds can be induced to germinate by various treatments.

In the present study, seed processing experiments were carried out to explore the possibility of using immediately harvested seed and also to improve the germination and vigour of seeds by simple processes like cleaning, upgradation and drying.

MATERIAL AND METHODS

A laboratory experiment was conducted at the Division of Floriculture and Landscaping in collaboration with the Division of Seed Science and Technology, Indian Agricultural Research Institute, New Delhi during 1998 - 1999 season. Two cultivars, one each of African marigold and

French marigold were chosen for investigation. One kilogram seed of both these cultivars from May 1998 harvest were obtained from seed production unit of IARI, New Delhi. The initial seed was dried and manually processed and was used for the experimental purpose. Seed cleaning and drying treatments were given alone and in combination. The treatments with significant data were (T_1) initial seed with mechanical drying, (T_2) seed cleaning and upgradation without drying, (T_3) seed cleaning and upgradation with mechanical drying and (T_4) initial seed (control). The data obtained from all the treatments were subjected to statistical analysis following Panse and Sukhatme (1985). The different procedures followed for seed processing are given here under.

Seed Cleaning and Upgradation

The seeds were cleaned and upgraded by ESM pneumatic separator using the movement of air to divide seeds according to their terminal velocities. When a seed mixture is introduced into the lower end of an expanding air column, heavy seeds fall against the air flow and light seeds are lifted. Since marigold seeds are very light in weight, the air velocity was standardized at 10 ms^{-1} by trial and error method.

Seed Drying

Seeds are highly hygroscopic living material and their moisture content depends upon temperature and relative humidity of surrounding air. In the experiment, seeds were dried by using air dryer at a temperature of 25°C for 2 hours. Later seeds were cooled down to room temperature. The process was repeated for several times until the desired moisture level was attained as shown in the Tables 1 and 2. After completion of every drying cycle, the seeds were tested for moisture content.

Moisture Content

The moisture content was determined by gravimetric method (air - oven). The principle of this method is the elimination of moisture from the seed by drying. Drying was done at a constant temperature in an oven at 103 ± 2°C for 17 hours (Anonymous, 1985). The moisture content was expressed as a percentage. Initial and final weights of seed samples (before and after drying) were taken to calculate moisture percentage.

$$\text{Moisture Content (\%)} = \frac{m_1 - m_2}{m_1} \times 100$$

Where m_1 = initial seed weight

m_2 = final seed weight

Germination Test

The germination test was conducted with 200 seeds per replication, 50 each in petriplate of 9 cm diameter. Three replications were maintained and were kept for germination (ISTA, 1985) at a temperature of 25°C in BOD. Observations were recorded on 6th and 9th day on germination under laboratory conditions.

Seedling Dry Weight (mg)

Ten normal seedlings after final (ninth day) count of germination test were dried in an oven at 85°C over night and their dry weights were recorded on an electronic balance.

Vigour Index

It was calculated by multiplying the total germination and dry weight of a seedling (mg).

RESULTS AND DISCUSSION

In order to improve the seed quality, seeds were processed and the data on germination and seedling vigour as influenced by seed processing

Table 1 : Effect of Seed processing on Germination and Vigour in African Marigold (*Tagetes erecta L*)

Treatment	Moisture Content (%)	Germination (%) First Count	Germination (%) Second Count	Dry wt. of 10 Seedling (mg)	Vigour Index (G% x SDW (mg))
T_1 (Mechanical Drying)	07.81	59.00	68.00	19.60	133.28
T_2 (Seed Cleaned and upgraded without drying)	10.47	80.50	95.50	19.50	186.22
T_3 (Seed Cleaned and upgraded with mechanical drying)	07.95	82.66	97.00	19.60	190.12
T_4 (Initial Seed)	7.79	52.00	60.00	19.3	115.8
CD ± (p = 0.05)	0.019	1.15	1.63	0.11	0.046

Table 2 : Effect of Seed processing on Germination and Vigour in French Marigold (*Tagetes patula L*)

Treatment	Moisture Content (%)	Germination (%) First Count	Germination (%) Second Count	Dry wt. of 10 Seedling (mg)	Vigour Index (G% x SDW (mg))
T_1 (Mechanical Drying)	7.78	54.00	68.00	17.20	116.96
T_2 (Seed Cleaned and upgraded without drying)	10.91	72.50	76.00	17.20	142.76
T_3 (Seed Cleaned and upgraded with mechanical drying)	8.03	83.00	96.00	17.20	164.21
T_4 (Initial Seed)	7.79	42.00	52.00	17.10	88.92
CD ± (p = 0.05)	0.02	1.63	1.63	0.016	0.015

(cleaning and drying) are presented in Table 1 and 2, respectively. The data indicated that the percentage of unfilled, immature and damaged or broken seeds were more in African type and the seeds which were separated by ESM pneumatic separator improved significantly the seed quality. In case of French marigold, seed quality was affected by the moisture and hence proper drying is needed to improve its germination.

Maintenance of high percentage of germination and vigour of seed till the time of next sowing is of great significance for success in stand establishment and crop growth. Therefore, the efforts were made to preserve the seed quality by conditioning the storage - factor since, the condition at which seed enters into storage had great influence on its germination and vigour or storability.

The longevity of seeds during storage is primarily controlled by the seed moisture content and storage temperature (Barton , 1961 and Harrington, 1972). Seed, being highly hygroscopic in nature, tends to gain moisture from the atmospheric humidity. It is commonly recognized that of the two factors, moisture content of the seed plays a greater role in governing its storability (Barton, 1961). Hence, storage of seed at low moisture level is advocated for better seed quality. This can be achieved by either storing seeds in a de-humified store or by drying the seed to a sufficiently low moisture level and then packing the same in moisture impervious containers or keeping dehydrating agents like calcium chloride vials in seeds.

Generally, a moisture content of 6 per cent and below is recommended for storing seed in moisture impervious containers (Tanwar and Singh, 1988). However, drying seeds to a level as low as 6 per cent or below is not always attainable employing commercial seed dryers. Hence, in the present study seed moisture was brought down to 7-8 per cent by drying seeds in a dehumidifier air dryer.

In conclusion, the results of the study revealed that the seed drying, cleaning and upgradation had greater influence on seed germination in both the marigold species studied. In African marigold, cleaning and upgradation of seed had greater influence where as in French marigold, seed drying had pronounced effect on germination which may be due to the break - down of dormancy causing substances during the drying process.

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Influence of Shade on Success and Growth of Soft - Wood Grafts in Cashew

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ABSTRACT

A pot culture experment was conducted at Cashew Research Station, Bapatla during 1996-97 to know the effect of shade on success of soft - wood grafting in cashew. Significant differences were found for all the characters except for plant height in different shade structures. The soft - wood grafts prepared and kept in structures that provide 50 per cent partial shade recorded maximum percentage of success (50.1% to 59.81%) under local agro-climatic conditions of Bapatla when compared to complete or no shade.

Key Words : Shade Success, Soft-wood, Grafts, Cashew.

Cashew (*Anacardium occidentale L.*) is one of the chief foreign exchange earning crops of India, being cultivated in 6,34,970 ha producing 4,17,830 tonnes of nuts (1995-96). To meet the demands of processing units and exports, import of cashewnuts has been increased during last two decades. There is an apparent need to realize more yields from cashew orchards both qualitatively and quantitatively. In the last two decades many high yielding varieties and hybrids in cashew have been developed. To improve the yields and to have the stable performance of hybrids, the recently developed softwood grafting was found to be the most easy, economical and deal as it was useful to produce large number of grafts in relatively short period of time. Proper care should be taken for highest graft take by providing proper environmental conditions to the grafts in the nursery. Light is essential for triggering photosynthetic activity and leads to better nourishment of grafts. The rate of photosynthetic activity varies with different shaded conditions. Keeping this in view, the present investigation was carried out to find out the best shade structure for success of soft - wood grafting.

MATERIAL AND METHODS

A pot culture experiment was conducted with three replications in a randomized block design at Cashew Research Station, Bapatla during 1996-97. The shade treatments included seven shade structures (SS_1 to SS_7) *viz.,* black coloured high density polythene sheets were used to provide 25 per cent (SS_1), 50 per cent (SS_2) 75 per cent (SS_3) and 100 per cent (SS_4) shade. In addition, trench with partial shade providing 12.5 to 20 per cent shade, partial shade (10 to 15 per cent) under coconut leaves (SS_6) and low cost humid chamber (SS_7) providing only diffused light. The vigorously growing BPP 6 was scion material and grafted over BPP-5 root stock retaining a pair of leaves on root stock. Standard and recommended practices were adopted for raising of rootstock seedings for softwood grafting in cashew. The prepared grafts were kept under various shade structures. Five grafts

Table 1 : Percentage of scion stickes sprouted at 15, 30 and 45 DAG in cashew as influenced by shade structures.

Treatments (Shade Structures)	Percentage of scion sticks sprouted			
	15 DAG	30 DAG	45 DAG	Total
SS_1	12.0	51.8	5.0	67.8
SS_2	17.5	47.1	7.8	72.4
SS_3	10.9	58.9	3.2	72.9
SS_4	8.0	23.6	0.6	32.2
SS_5	9.9	56.4	1.0	67.2
SS_6	10.1	68.6	0.6	79.2
SS_7	9.0	46.3	11.1	66.3
Mean	11.0	50.4	4.2	
CD (p=0.05)	0.05	0.08	0.03	
CV%	28.18	16.62	29.41	

were selected from each treatment at random and tagged for continuous record of the data on percentage of scion sticks sprouted, percentage of success, number of leaves per graft, height of the graft and total leaf area per graft.

RESULTS AND DISCUSSION

Among the seven shade structures the maximum sprouting percentage was recorded by SS_2 (17.52%) within 15 days after grafting (DAG), by SS_6 (68.57%) within 30 DAG and by SS_7 (11.08%) within 45 DAG. Considering the total number of scion sticks sprouted during 45 DAG, the maximum number of sprouts were recorded by SS_6 (79.23%) and minimum was recorded by SS_4 (32.19%). It is also clear from the Table 1 that the percentage of sprouting was maximum during 15 to 30 DAG in all the treatments. After 30 DAG the percentage of sprouting in all treatments was very limited indicating that the procured scion sticks generally take 15-30 days for complete sprouting after grafting by which the metabolites present in the scion sticks will be utilized by the sprouting buds.

Table 2 : Influence of shade on growth and success of soft-wood grafting in cashew (90 DAG.)

Treatments (Shade Structures)	Plant height (cm)	Leaf number	Leaf area (cm²)	Success (%)
SS_1	22.0	9.8	194.1	45.9
SS_2	21.6	10.4	188.5	50.1
SS_3	21.2	10.1	174.9	54.5
SS_4	21.8	8.8	144.9	29.7
SS_5	23.2	19.8	200.1	59.8
SS_6	22.2	11.7	202.5	50.5
SS_7	22.3	9.2	171.0	44.8
CD (p=0.05)	1.13	1.36	22.5	0.08
CV%	8.47	22.22	19.84	17.87

Although non significant differences found in height of grafts kept in different shade structures (Table 2), the grafts prepared and kept in trench (SS_5, 23.18cm) with partial shade recorded maximum graft height (Anonymous, 1994). There were significant differences in number of leaves and leaf area per graft due to different shade structures. The structure which provides partial shade (SS_6, 11.66) under coconut leaves followed by SS_7 (19.81) found to be useful in the production of leaves with larger leaf area (202.5cm² and 200.1 cm², respectively) compared to the structure providing complete shade (SS_4, 144.9 cm²). The complete shading effected the leaf size by partially preventing the radiation to fall on the grafts resulting in the reduction of photosynthetic efficiency of the graft. This might have affected the leaf area as confirmed by the findings of Saito and Ito (1967) and Sankar Reddy (1983).

The percentage of successful grafts were significantly influenced by shade structures among which, trench with partial shade (SS_5) recorded maximum success (59.81%) followed by SS_3 and SS_6. The trenches were made to a depth of 3 feet and temperatures were recorded and presented in Table 3. This data clearly indicated the maintenance of constant

Table 3 : Temperature and Relative humidity in Trench (at 2pm) during the experimental period

Month	Temperature (°C)	Relative Humidity (%)
September',96	30.50	88.0
October',96	29.5	91.0
November',86	30.0	89.0
December',96	30.50	91.0
January',97	32.0	93.0
February',97	34.5	92.0
March',97	36.5	90.0

temperatures and high relative humidity in trenches. Thus the prevailing constant optimum favourable temperatures in the trenches might be conductive for better healing of the cambial region of the graft. The lowest success was recorded by grafts under 100 per cent shade where there is no provision for synthesis of assimilates by the sprouted scion sticks. This was confirmed by the earlier reports of Seshadri and Rama rao (1986) in cashew and Panicker and Desai (1989) in mango.

It can be concluded that the grafts prepared and kept in structures that provided partial shade (10% to 75%) *viz.*, SS$_6$,SS$_5$,SS$_2$, and SS$_3$ gave high percentage of success and trench with partial shade was found to be the best under local agro-climatic conditions of Bapatla.

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Effect of Plant Growth Regulators on Growth and Herbage Yield of Palmarosa

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ABSTRACT

The field experiment conducted to study the effect of plant growth regulators (NAA, GA_3 and BA at 50,100 and 200 ppm and Ethrel at 300, 750 and 1000 ppm) and water as control on growth and herbage yield of palmarosa Cv Trishna during 2001 - 2002 revealed that foliar spray of GA_3 200 ppm thrice at monthly intervals starting from 30 days after transplanting can be considered for obtaining higher herbage yield, essential oil content and oil yield of palmarosa. The plant height, (284.86 cm), number of tillers per plant (43.46) and number of leaves per tiller (9.87) were significantly influenced by GA_3 200 ppm solution.

Key Words : Plant Growth Regulators; Herbage Yield, Palmarosa, NAA, GA_3, BA.

Cultivation of medicinal and aromatic plants for their active principles and essential oils are highly remunerative. Palmarosa oil is the largest commercial source of pure natural geraniol which is preferred over synthetic geraniol as well as the oils of citronella and palmarosa. (Kumar *et al.*, 1997). Concerted efforts are required to promote herbage yield and oil yield of palmarosa in non-traditional areas. Plant growth substances have proved their potential in commercial use in regulating many processes of the plant and improved growth and yield of many crops. The present investigation was under taken to study the effect of plant growth regulators on growth, herbage and oil yield of palmarosa under local agro - climatic conditions.

MATERIAL AND METHODS

The study was conducted at Agricultural College Farm, Bapatla during 2001 - 02 on sandy loam soil, which was low in organic carbon, available N, medium in available P_2O_5 and K_2O and with pH and E.C. of 7.8 and 0.5 dsm^{-1},NAA, GA_3, BA respectively. The experiment was laid out in randomised block design with three replications. The cultivar Trishna was sown in a raised nursery bed and 60 days old seedlings were transplanted on 11th October, 2001. All the recommended cultural practices were followed. Harvesting was done for different treatments twice, the first at 137 days after transplanting and second after another 60 days. Observations regarding growth (plant height, number of tillers per plant and number of leaves per tiller), herbage yield and oil content and oil yield of palmarosa were recorded and the data was statistically analysed as suggested by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Growth Parameters

The growth parameters like plant height, number of tillers per plant and number leaves per tiller at the time of first cutting and second cutting

Table 1 : Effect of plant growth regulators and their concentrations on growth of palmarosa.

Treatments	Plant height (cm)		Number of tillers per plant		Number of leaves per tiller	
	First cutting	Second cutting	First cutting	Second cutting	First cutting	Second cutting
NAA 50 ppm	231.17	191.16	32.06	54.20	7.97	7.20
NAA 100 ppm	223.82	198.33	37.88	56.33	8.83	7.60
NAA 200 ppm	211.94	173.33	38.00	56.93	9.40	7.80
GA_3 50 ppm	249.66	196.42	33.68	56.20	8.84	7.06
GA_3 100 ppm	257.50	199.16	36.40	67.80	8.93	7.60
GA_3 200 ppm	284.86	212.18	43.46	54.20	9.87	8.20
BA 50 ppm	218.22	195.33	35.53	65.06	8.33	7.40
BA 100 ppm	221.24	196.90	37.96	57.33	9.17	7.20
BA 200 ppm	223.92	185.33	20.00	46.20	7.82	7.0
Etherl 300 ppm	193.08	196.33	33.20	53.53	7.62	7.40
Etherl 750 ppm	190.42	189.53	37.86	49.73	7.10	7.20
Etherl 1000 ppm	184.62	191.83	26.13	41.00	6.35	7.0
Control (Water spray)	213.53	201.46	30.66	55.66	7.73	7.2
SEm±	11.31	6.49	2.45	5.16	0.28	0.34
C D (0.05)	33.04	NS	7.17	NS	0.82	NS
C V %	8.77	5.77	12.93	16.28	5.90	8.17

as influenced by plant growth regulators and their concentrations are presented in Table 1. The data showed significant differences among treatments at first cutting and non significant differences at second cutting. The plant growth regulator GA_3 200 ppm remarkably showed significant superiority for plant height (284.86 cm) over other plant growth regulators and control (water spray). However, among the concentrations of GA_3, there were no significant differences. The superiority of gibberllic acid in promoting the growth characters could be attributed to the typical action of gibberellins on higher plants in stem elongation. In recent years, it has been proved that GA_3 not only affects cell elongation but also cell division in sub apical tissues of the plant. Further GA_3 has been found to increase cell wall activity thus creating water diffusion pressure deficit which results in water uptake and there by causing cell elongation (Randhawa, 1971). Similar results of increased plant height under influence of GA_3 were reported by Mohamad *et al.*, (1983) in geranium, Bhat *et al.* (1990) in davanam and Jagmohan *et al.* (1993) in rosemary. The beneficial effects of GA_3 200 ppm for production of maximum number of tillers per plant (43.46) could be attributed to an increased rate of photosynthetic activity, accelerated transport and efficiency of utilizing assimilates thus resulting in the cell elongation and rapid cell division in the growing stage as reported by Sokhi and Sokhi (1991). Pertaining

Table 2 : Effect of plant growth regulators and their concentrations on yield parameters of palmarosa.

Treatments	Herbage yield (g plant^{-1})		Oil content (%)		Oil yield (ml plant^{-1})	
	First cutting	Second cutting	First cutting	Second cutting	First cutting	Second cutting
NAA 50 ppm	288.13	233.23	0.56	0.53	1.55	1.20
NAA 100 ppm	340.62	286.40	0.57	0.50	1.20	1.90
NAA 200 ppm	341.21	295.00	0.61	0.52	2.10	1.50
GA_3 50 ppm	273.74	262.13	0.58	0.53	1.60	1.40
GA_3 100 ppm	296.26	262.00	0.60	0.56	1.80	1.40
GA_3 200 ppm	446.99	282.33	0.62	0.53	2.80	1.60
BA 50 ppm	283.26	265.33	0.56	0.52	1.60	1.40
BA 100 ppm	316.66	225.33	0.56	0.48	1.80	1.20
BA 200 ppm	184.90	182.33	0.52	0.51	1.0	0.90
Etherl 300 ppm	300.13	241.33	0.58	0.52	1.70	1.20
Etherl 750 ppm	344.95	224.33	0.62	0.52	2.10	1.20
Etherl 1000 ppm	213.63	200.00	0.54	0.53	1.20	1.0
Control (Water spray)	227.14	212.33	0.54	0.52	1.30	1.10
SEm±	32.82	28.90	0.02	0.016	0.20	0.71
C D (0.05)	45.81	NS	0.06	NS	0.60	NS
C V %	19.16	20.52	6.3	5.47	20.69	19.32

to number of leaves per tiller GA_3 200 ppm (9.87) showed its superiority indicating that GA_3 is needed not only for stem growth but also for leaf development. The non-significant differences recorded at second cutting stage among the treatments could be attributable to removal of hormonal action endogenously by first cutting and thus might have resulted in uniformity of the plant growth characters. In the present study growth characters were not improved over control with the spraying of NAA. Similarly BA sprayings have not shown any beneficial effect in promoting the growth. The poor influence of BA over control in the present study could be attributable to very restricted movement of cytokinin within the plant as suggested by Thimann (1964). The inferior influence of ethylene could be attributed to its growth retarding action as suggested by Verma (1945).

Herbage yield

The effect of plant grwoth regulators and their concentration on fresh herbage yield per plant presented in Table 2, showed significant superiority of GA_3 200 ppm over all other plant growth regulators. It could be due to increased growth affected by GA_3. Further the significant differences for first cutting and non-significant differences for second cutting in present study could be attributable to the influence of plant grwoth regulators in the vegetative phase of the plant. Further, the removal of herbage by first cutting might have removed the residual content of plant growth regulators and thus showed non-significant differences for these characters. In other worlds the effectiveness of plant growth regulators may be upto first cutting stage. However, the total yield of both the cuttings when pooled, significant results were recorded. In that case also spraying of GA_3 200 ppm was found to be the most effective one. Similar results of increased yield due to GA_3 was reported by Mohamad *et al.* (1983) in geranium and Randhawa (1988) in mentha.

Oil Content and Yield

The data presented in Table 2 for oil content and oil yield showed significant differences at first cutting only. Among the plant growth regulators GA_3 200 ppm recorded maximum oil content and oil yield per plant. Formation of oil in a plant takes place when intermediate products of carbohydrate metabolism are in more quantity than necessary. Therefore in present study, GA_3 might have enhanced vital activities of cell during dissimulation of carbohydrates and proteins resulting in more oil formation as explained by Kewalanand *et al.* (1998). In this case also the significant differences were noted upto first cutting only which could be attributable to the retention of residual activity in the aerial parts of the plant upto first cutting stage.

It could be concluded that even under local agro-climatic conditions i.e. tropical coastal humid sandy soils of Bapatla, Palmarosa can be grown successfully. Further, for increased production of herbage and essential oil yield, spraying of GA_3 200 ppm thrice at monthly intervals starting from 30 days after transplanting was found beneficial.

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Study on The Efficiency of EMS in Inducing Mutations in Water Melon, *Citrullus lanatus (Thunb)* Mansf.

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ABSTRACT

Watermelon seeds when treated with EMS at 0.2%, 0.4% and 0.6% concentrations revealed that there was an increase in seedling injury, per cent of female flowers per 100 male flowers, pollen fertility, fruit length, fruit weight, number of fruits per vine and yield per vine where as; there was a decreasing trend in vine length, number of branches per vine, and seed fertility when compared to control.

Key Words : Inducing Mutations, Watermelon, Male flowers, Female Flowers, Pollen.

Watermelon is a well known and widely cultivated crop grown for its sweet and juicy pulp. The fruit is cooling in effect and the flesh is a source of pectin (0.09% - 0.1%) which is used in jelly making. Induced mutations by their very nature offer a simple alternative to conventional breeding methodologies. Hence the present study was undertaken to study the effects of various doses of EMS in inducing desirable changes in watermelon.

MATERIAL AND METHODS

The present study was conducted at Nutrition Garden, Agricultural College, Bapatla during spring- summer 2000 using CV. Arka Manik. For this, well filled dry watermelon seeds were selected and soaked in double distilled water for 8 hrs prior to treatment with mutagen solutions. Solutions of 0.2%, 0.4 % and 0.6% concentration of EMS were prepared using phosphate buffer (pH 7.0). Seeds soaked in phosphate buffer (pH 7.0) were kept as control.

RESULTS AND DISCUSSION

Among the various treatments 0.2% EMS was found to be superior in terms of vine length, per cent of female flowers per 100 male flowers, pollen fertility, fruit length, fruit weight, number of fruits per vine and yield per vine.

Seedling Injury

There was an increase in seedling injury with increase in dose of EMS. This may be due to the inhibition of auxin synthesis (Skoog, 1935) and decline of assimilation mechanism (Quastler and Baer, 1950). Highest seedling injury was recorded in 0.6% EMS (22.22) treatment.

Vine Length

Vine length decreased with increase in dose of EMS except in case of 0.2% EMS which recorded an increase in vine length over control (329.97 cm). This may be attributed to hormonal and biochemical changes consequent to the mutagenic treatments as suggested by Blinks (1952). Reduction in vine length could be due

Table - 1 Effect of Ethyl Methane Sulphonate (EMS) on watermelon

Treatment	Seedling injury	Vine length at maturity (cm)	Mean No. of branches per vine	Per cent of female flowers per 100 male flowers	Pollen fertility	Seed fertility	Fruit length (cm)	Fruit weight (Kg)	Number of fruits per vine	Yield per vine (Kg)
Control	0.00	317.60	11.0	6.9	74.51	85.86	17.36	2.77	1.78	5.19
0.2% EMS	0.00	329.97	9.22	7.3	95.38	79.17	20.57	3.89	4.00	16.09
0.4% EMS	16.67	317.10	8.72	8.6	79.17	79.06	18.78	2.52	3.22	9.14
0.6% EMS	22.22	300.80	6.94	7.3	63.21	81.58	16.28	1.71	3.11	7.84

to inhibition of mitosis in growing points as suggested by Gunckel (1957).

Number of Branches Per Vine

Number of branches per vine were decreased with the increase in dose of EMS. The highest number of branches per vine (11) were recorded in control.

Per cent Female Flowers Per 100 Male Flowers

The per cent female flowers per 100 male flowers was increased with increase in dose of EMS upto 0.4% and later decreased. However, the EMS treatments showed increased female flowers over control. The reason may be attributed to the increased level of neutral auxins, which are responsible for early induction of female flowers (Heslop - Harrisson, 1963). The sexual differentiation was controlled by the endogenous level of auxins in the regions neighboring the flowering primordia and during flowering the formation of pistillate organs may be favoured by high auxin level.

Pollen Fertility

Pollen fertility was decreased with increase in dose of EMS. However, 0.2% EMS recorded the highest pollen fertility (95.38). The decrease in pollen fertility among EMS treatments may be attributed to the gene mutations although cytologically undetectable cryptic structural changes may also contribute to some extent as suggested by Sharma and Sharma (1979).

Seed Fertility

Seed fertility increased with increase in dose of EMS except 0.4% EMS which recorded the lowest seed fertility (79.06). However, control treatment recorded the highest seed fertility (85.86). The decrease in seed fertility over control may be attributed to mutant gene which acts as a foreign element and disturbs the genic harmony of the genome resulting in the in specific reduction of seed fertility of mutants (Gaul *et al.*, 1966).

Fruit Length

The fruit length decreased with increase in dose of EMS. Maximum fruit length of 20.57 cm was recorded by 0.2% EMS concentration. Similar results were reported by Laximi and Gupta (1983) in fenugreek.

Fruit Weight

Similarly fruit weight also showed a decreasing trend with increasing dose of EMS. Maximum fruit weight of 3.89 kg was recorded by 0.2% EMS concentration. Similar results were reported by Laximi and Gupta (1983) in fenugreek.

Number of Fruits Per Vine

EMS treatments recorded more number of fruits per vine over control. But fruit number was decreased with increasing dose of EMS. Maximum number of fruits per vine was also recorded by 0.2% EMS concentration. Similar results were reported by Laxmi and Gupta (1983) in fenugreek.

Yield Per Vine

EMS treatments recorded more yield per vine over control. But the yield was decreased with increase in dose of EMS. Maximum yield per vine of 16.09 kg was recorded by 0.2% EMS. The reason for increase in fruit number per vine could be attributed to transient modification or heritable mutation. The increased yield was may be due to cumulative effect of all yield attributing traits. Similar results were reported by Maloo and Agarwal (1995) in niger.

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Effect of Fertiligers and GA_3 on Growth of Curry Leaf (*Murraya Koenigii* Spreng.)

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ABSTRACT

Studies on the effect of various levels of NPK along with GA_3 on vegetative growth of curry leaf carried out at the Olericulture section of the Department of Horticulture, University of Agricultural Sciences, Dharwad, revealed that the nutrients and GA_3 have profound effect on increasing the vegetative growth of curry leaf bushes. Application of treatment combination of 500 : 150 : 150 of NPK / plant along with 150 ppm GA_3 was found to produce maximum growth in curry leaf.

Key Words : Fertilizers, Curry Leaf, Olericulture, Vegetative, NPK, GA.

Curry leaf is one of the fifty two spices identified by the spice board of India. It constitutes part of every day food item in South Indian cokkery. Apart from providing excellent flavour to food, it contributes to the mineral and essential vitamin requirement of human body and also posses medicinal value. The leaves and roots are slightly bitter, cooling, anthelmintic, analgesic and are known to cure piles, thirst, inflammation and itching (Kirthikar and Basu, 1935). Leaves are also used as antiperiodic and many a times, the dry leaf mixed with honey and juice of betelnut is recommended in ayurvedic medicine (Pruthi, 1984). For years in addition to its therapentic values, curry leaf has enjoyed a unique status as a flovouring principle in Indian cuisine. Inspite of its many uses, little or no attempt has been made to cultivate curry leaf an scientific basis. Normally the crop being grown as a back yard crop, very less information on nutritional and growth regulator responses have been reported except Balaji (1989), Bhagavantagoudra (1990) and Patil (1991). But there were no reports on the fertilizer needs of twelve years old plantations. The present investigation was carried out to know the effect of the same.

MATERIAL AND METHODS

The field experiment was conducted at the olericulture section of the New orchard, Department of Horticulture, University of Agricultural Sciences, Dhrawad during 1998-99. The Soil of the experimental site was red sandy clay and experiment was laid as randomised block design with two factors and replicated thrice. There were five levels of fertilizer combinations (300 - 50 -50; 350 - 60 - 60; 400 - 75-75; 450-100 - 100; 500 - 150 - 150 g NPK/ plant) and three levels of GA_3 concentrations (100 ppm, 125 ppm,150 ppm,) with 15 treatment combinations (5 x 3). The experiment was carried out with the variety "Suvasini". The nutrients N,P and K were supplied in the form of Urea, SSP and Mop in 3 split doses.

Table 1 : Effect of nutrition and GA_3 on number of new shoots produced on the main stem in curry leaf

GA_3 Conc.	I Clipping				II Clipping				III Clipping			
Fertilizer levels	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean
F_1	74.6 (8.7)	81.0 (9.0)	85.6 (9.3)	80.4 (9.0)	77.0 (8.8)	84.3 (9.2)	92.3 (9.6)	84.5 (9.2)	78.6 (8.9)	86.7 (9.3)	94.6 (9.8)	86.6 (9.3)
F_2	93.3 (9.7)	99.9 (10.0)	108.9 (10.5)	100.7 (10.1)	101.9 (10.1)	108.3 (10.4)	111.6 (10.6)	107.3 (10.4)	107.3 (10.4)	116.7 (10.8)	122.3 (11.1)	115.4 (10.8)
F_3	116.9 (10.8)	118.6 (11.7)	112.3 (11.1)	119.3 (10.9)	120.6 (11.0)	125.7 (11.2)	128.3 (11.4)	124.9 (11.2)	126.7 (11.3)	132.6 (11.5)	133.7 (11.6)	131.0 (11.5)
F_4	131.0 (11.5)	137.0 (11.7)	143.0 (11.9)	137.0 (11.7)	133.3 (11.6)	141.6 (11.9)	147.3 (12.2)	140.7 (11.9)	139.7 (11.8)	144.3 (12.0)	147.9 (12.2)	143.9 (12.0)
F_5	148.0 (12.2)	154.0 (12.4)	160.0 (12.7)	154.0 (12.7)	154.3 (12.4)	157.6 (12.6)	163.0 (12.8)	158.3 (12.6)	154.7 (12.5)	158.7 (12.6)	164.3 (12.8)	159.2 (12.6)
Mean	112.6 (10.6)	118.1 (10.8)	123.9 (11.1)	118.2 (10.8)	117.4 (10.8)	123.5 (11.1)	128.5 (11.3)	123.1 (11.1)	121.4 (10.9)	127.8 (11.2)	132.6 (11.5)	127.3 (11.2)
For comparison of Means :			S.Em±	CD(5%)			S.Em±	CD(5%)			S.Em±	CD(5%)
		F	0.07	0.20			0.09	0.26			0.08	0.23
		G	0.05	0.14			0.14	0.60			0.05	0.14
		FXG	0.12	0.35			0.35	0.40			0.15	0.43

G_1 :100 ppm GA_3 concentration
G_2 :125 ppm GA_3 concentration
G_3 :150 ppm GA_3 concentration

During the course of investigation growth parameters like number of new shoots, length of new shoots, number of leaves were recorded. All the data were subjected to analysis of variance.

RESULTS AND DISCUSSION

It is evident from the results that the curry leaf plants produced maximum number of new shoots, length of new shoots and number of leaves, when they were supplied with fertilizer levels of 500 : 150 : 150 g NPK / plant along with 150 ppm GA_3. In I, II and III clippings, F_5 among fertilizer levels, G_3 among GA_3 concentrations recorded maximum growth. The treatment in respect of F_5G_3 recorded significantly highest number of new shoots (160, 163, 164.3, respectively), length of shoots (90.1 cm, 93.9 cm and 98.0 cm, respectively) and number of leaves (33.7, 36.6 and 41.6, respectively). Minimum growth was recorded by the plants with the fertilizer levels of F_1, GA_3 concentration (Tables 1-3).

General the bushes supplied with a fertilizer dose of 500 : 150 : 150 g NPK / bush produced the maximum yield where as, the lowest yield was recorded in the bushes supplied with a fertilizer dose of 300 : 50 : 50 g NPK / plant. The increase in the yield was due to its yield attributing characters like number of new shoots, length of new shoots and number of leaves. The increase in the growth due to the application of fertilizers especially nitrogen has been reported in pepper vines (Pillay *et al.*, 1979;

Table 2 : Effect of nutrition and GA$_3$ on number on lenth of new shoots in curry leaf (cm)

GA$_3$ Conc.	I Clippingt				II Clipping				III Clipping			
Fertilizer levels	G$_1$	G$_2$	G$_3$	Mean	G$_1$	G$_2$	G$_3$	Mean	G$_1$	G$_2$	G$_3$	Mean
F$_1$	47.5	50.1	62.8	50.2	46.1	53.5	56.1	51.9	53.5	54.9	57.7	55.4
F$_2$	56.9	60.8	62.9	60.2	56.9	61.9	63.8	61.5	65.5	67.1	69.9	67.5
F$_3$	73.1	73.9	75.3	74.1	70.6	74.6	75.6	73.6	74.0	75.1	78.6	75.9
F$_4$	80.4	81.9	82.1	81.4	79.3	84.3	84.8	82.8	85.3	86.6	89.9	87.3
F$_5$	86.6	87.3	90.1	87.9	88.4	90.3	93.9	90.9	93.2	96.4	98.0	95.9
Mean	68.9	70.8	72.6	70.8	68.6	72.9	74.8	7.21	58.9	76.0	78.8	71.2
For comparison of Means :			S.Em±	CD(5%)			S.Em±	CD(5%)			S.Em±	CD(5%)
		F	0.59	1.73			0.56	1.61			0.49	1.40
		G	0.44	1.34			0.43	1.22			0.36	1.08
		FXG	1.04	3.01			0.96	2.78			0.84	2.43

F$_1$: 300 : 50 : 50g NPK / plant
F$_2$: 350 : 60 : 60g NPK / plant
F$_3$: 400 : 75 : 75g NPK / plant
F$_4$: 450 : 100 : 100g NPK / plant
F$_5$: 500 : 150 : 150g NPK / plant

G$_1$: 100 ppm GA$_3$ concentration
G$_2$: 125 ppm GA$_3$ concentration
G$_3$: 150 ppm GA$_3$ concentration

Sadanand and Nair, 1973). They opined that since nitrogen forms the constituent of proteins and component of protoplasm, the application of nitrogenous fertilizers must have favoured the higher rate of protein synthesis, there by increasing the multiplication of cells and thus contributing to increased plant growth. The improvement in morphological parameters under the influence of nitrogen might have resulted in larger canopy development and presumably higher chlorophyll content of leaves, since nitrogen is a component of chlorophyll molecule. Increase in the growth of curry leaf plants with increasing levels of phosphorus was due to its role as a constituent of sugar phosphates, ADP, ATP, nucleic acids, nucleoproteins, purines and pyramidines, flavin nucleotides and sevral co-enzymes *viz.*, NADP, pyridoxyl phosphate and thiamine pyrophosphate (Agarwal and Sharma, 1976).

Potassium application was found to increase the growth of the bushes and it continued to increase upto 150 g / bush. It is a well known fact that potassium play an important role in the maintenance of cellular organization by regulating the permeability of cellular membranes and keeping the protoplasm in a proper degree of hydration by stabilizing the emulsions of highly colloidal particles.

In the present investigation, GA$_3$ at 150 ppm along with all the levels of fertilizers found to increase the growth of curry leaf bushes. There was an increase in the length of new shoots, which can be further attributed to an increase in the internodal length caused by GA$_3$. These findings are in confirmity with that of Marth *et al.* (1965) who observed that different concentrations of GA, applied on 49 different kinds of plants, increased the internodal length through cell division and cell elongation. The increase yield in curry leaf due to GA$_3$ spray could

Table 3 : Effect of nutrition and GA_3 on number on lenth of new shoots in curry leaf (cm)

GA_3 Conc.	I Clippingt				II Clipping				III Clipping			
Fertilizer levels	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean
F_1	15.2	15.4	16.7	15.8	15.5	16.4	17.1	16.3	17.4	17.7	17.9	17.7
F_2	17.8	18.3	19.4	18.5	18.3	19.6	20.7	19.5	18.8	19.4	21.3	19.8
F_3	21.7	22.8	23.0	22.5	22.5	22.9	23.9	23.1	22.5	24.0	26.3	24.3
F_4	25.2	26.0	28.0	26.4	25.8	27.5	30.3	27.9	28.1	31.2	33.1	30.8
F_5	30.5	31.6	33.7	31.9	32.6	34.9	36.6	34.7	36.2	37.2	41.6	38.3
Mean	22.1	22.8	24.2	23.0	22.9	23.4	25.7	24.0	24.6	25.9	28.0	26.2
For comparison of Means :			S.Em±	CD(5%)			S.Em±	CD(5%)			S.Em±	CD(5%)
		F	0.19	0.54			0.27	0.77			0.25	0.71
		G	0.15	0.42			0.21	0.60			0.19	0.55
		FXG	0.33	0.96			0.46	1.33			0.43	1.23

F_1 : 300 : 50 : 50g NPK / plant
F_2 : 350 ; 60 : 60g NPK / plant
F_3 : 400 : 75 : 75g NPK / plant
F_4 : 450 : 100 : 100g NPK / plant
F_5 : 500 : 150 : 150g NPK / plant

G_1 : 100 ppm GA_3 concentration
G_2 : 125 ppm GA_3 concentration
G_3 : 150 ppm GA_3 concentration

be attributed to the increased number of leaves, which have direct influence on yield.

Considering the significant results, it is quite evident that the curry leaf plants need higher fertilizer levels along with GA_3 for sustained production over a period of one year with four clippings.

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Effect of Planting Time on Bulb Growth and Yield of Onion Cultivars

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ABSTRACT

Studies on onion cultivars, indicated that bulb characters were higher with October 15 transplanting with a mean highest bulb yield of 6.02 kg / 1.35 m². Among cultivars, Arka Niketan and N-53 performed well and recorded the mean highest yield of 4.14 kg / 1.35 m² and 4.04 kg / 1.35 m². Among the interaction effects of dates of transplanting and the cultivars, the cultivars Arka Niketan and N-53 when transplanted on October 15th recorded the highest yields of 7.42 and 6.59/1.35 m² area, respectively. Earliness of bulb initiation was observed with progressive delay in transplanting. Similarly, the time required to bulb maturity was also found to be early with progressive delay in transplanting. Among cultivars Agri Found Dark Red showed earliness in bulb initiation and bulb maturity but Arka Niketan and N-53 showed longer days of bulb initiation and days to bulb maturity by three and two days, respectively over Agri Found Dark Red.

Key Words : Planting Time, Bulb Growth, Agri Found Dark Red, Arka Niketan, N-53, Milky White, Rampur Light Red.

Onion, an important condiment and vegetable grown in India is very much sensitive to temperature and photo period. In most of the varieties bulb formation was favoured by high temperature and long photo period (Thompson and Kelly, 1957) and bulb yield was greatly affected by planting dates (Singh, 1993). Successful bulb production depends upon the selection of cultivars that grow satisfactorily under the conditions imposed by specific environment. The information regarding optimum planting time and promising cultivars of onion for different agro - climatic conditions is not available. Therefore, the present investigation was undertaken to select suitable onion cultivar as well as optimum date of transplanting under local agro-climatic conditions of Bapatla.

MATERIAL AND METHODS

An experiment was conducted at Agricultural College Farm, Bapatla during 1999 - 2000 to study the effect of planting date on growth and yield of onion cultivars. The experiment was laid out in factorial R.B.D. and replicated thrice with six dates of transplanting (August 15, September 15; November 15; December 15, 1999 and January 15, 2000) and five cultivars of onion (N-53, Agri Found Dark Red, Milky White, Rampur Light Red and Arka Niketan). The experimental soil was sandy clay loam with pH 7.7. Organic Carbon, available N, available P_2O_5 and available K_2O were 0.44%, 26.4 kg ha^{-1}, 19.72 kg ha^{-1}, and 410.08 kg ha^{-1} respectively. Uniform cultural practices were carried out in the experimental plot. Observations were recorded on days to bulb initiation, days to bulb maturity, bulb characters and yield per 1.35 m^2 area and the data were subjected to statistical analysis as suggested by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Effect of Dates of Transplanting

Dates of transplanting had significant effect on days to bulb initiation and bulb maturity (Table 1). January planting recorded minimum number of days to bulb initiation (52.46) and bulb maturity (99.73). Days to bulb initiation and bulb maturity was shortened as there was delay in transplanting date. It could be attributed to the fact that the plants of early transplanting (Prior to October 15) might have been subjected to warmer temperature coupled with rainfall which in turn might be responsible for continuous

Table 1 : Effect of different dates of transplanting and cultivars on days to bulb initiation and bulb maturity.

Treatment	Days to bulb initiation	Days to bulb maturity
Dates of transplanting		
August 15, 1999	82.87	135.07
September 15, 1999	78.27	126.06
October 15, 1999	65.07	119.80
November 15, 1999	60.80	111.93
December 15, 1999	55.47	107.13
January 15, 2000	52.46	99.73
CD (P = 0.005)	0.508	0.509
Varieties		
N-53	65.67	117.72
Agri Found Dark Red	62.83	115.83
Milky White	68.28	116.17
Rampur Light Red	64.00	115.06
Arka Niketan	68.33	118.78
CD (P = 0.05)	0.463	0.466

Table 2 : Effect of dates of transplanting and cultivars on Bulb characters and yield.

Treatment	Bulb length (cm)	Bulb diameter (cm)	Bulb weight (g)	Yield per plot (kg / 1.35 m^2)
Dates of transplanting				
August 15, 1999	5.82	6.03	78.96	3.55
September 15, 1999	5.33	6.63	107.96	4.82
October 15, 1999	5.50	7.84	132.59	6.02
November 15, 1999	4.74	6.18	73.30	3.30
December 15, 1999	4.39	5.38	42.88	2.48
January 15, 2000	3.98	4.16	31.99	1.44
CD (P = 0.005)	0.058	0.091	1.735	0.094
Varieties				
N-53	4.98	6.25	89.76	4.04
Agri Found Dark Red	4.93	5.94	73.29	3.30
Milky White	4.90	6.02	76.23	3.43
Rampur Light Red	4.94	5.68	68.98	3.10
Arka Niketan	5.04	6.28	90.90	4.14
CD (P = 0.05)	0.055	0.083	1.586	0.086

Table 3 : Interaction effect of dates of transplanting and onion cultivars on yield (kg /1.35m²)

Dates of transplanting	N-53	Agri Found Dark Red	Milky White	Rampur Light Red	Arka Niketan	Mean
		Varieties				
August 15, 1999	4.63	2.97	3.68	2.64	3.85	3.35
September 15, 1999	5.06	4.71	4.60	4.32	5.40	4.82
October 15, 1999	6.59	5.59	4.89	5.62	7.42	6.02
November 15, 1999	3.77	2.92	3.22	2.82	3.77	3.30
December 15, 1999	2.50	2.31	2.89	1.95	2.75	2.48
January 15, 2000	1.68	1.29	1.32	1.27	1.62	1.44
Mean	4.04	3.30	3.43	3.10	4.14	

	Dates of transplanting	Cultivars	Interaction of Dates of transplanting and cultivars
CD (P = 0.05)	0.094	0.086	0.213

vegetative growth. Contrarily, the plants of delayed transplanting (beyond October 15) under local agro - climatic conditions showed early bulb formation and maturity which could be due to early completion of vegetative growth because of mild winter temperature that are usual in the local tract. These results are in tune with the findings of Khokhar *et al.* (1990).

Maximum bulb length (5.82 cm) was recorded by the onion bulbs of August transplanted crop. However, maximum bulb diameter (7.84 cm) and bulb weight (132.59 g) were recorded on October 15 transplanting (Table 2). The probable reason for the variation in bulb length and bulb diameter due to dates of transplanting could be due to variation in the period of bulb initiation to bulb maturity. Similar results were reported by Singh and Singh (1974). The greater bulb weight could be due to large size by virtue of diameter and length.

The highest bulb yield per plot was recorded by October 15 transplanting (6.02 kg / 1.35 m²). A successive decline in the yield was recorded with delay in planting beyond October transplanting and a progressive earliness in case of early transplantings before October 15. It indicated that the onion crop transplanted on October 15 was under favourable climate of relative warmer temperature and optimum light duration for vegetative growth before bulb initiation and relatively cooler temperature and optimum time subsequently that might have helped for bulb development under local agro-climatic condition. Thus this favourable climatic conditions before and after bulb initiation might be responsible for the production of higher yields under local agro-climatic conditions.

Effect of cultivars

While early bulb initiation (62.83) was recorded by Agri Found Dark Red and days to bulb maturity was recorded minimum by the Cv. Rampur Light Red (115.06), maximum bulb length, bulb diameter and bulb weight were recorded by Arka Niketan followed by N-53

(Table 2). Similar results were reported by Dod *et al.* (1993) in onion. The highest yield per plot was recorded by Arka Niketan (4.14 kg / 1.35 m²) followed by N-53 (4.04 kg 1.35 m²). The interaction of dates of transplanting and varieties had significant effect on yield (Table 3). Cultivars Arka Niketan and N-53 gave higher bulb yield per plot when transplanted on October 15(7.42 kg / 1.35 m² and 6.45 kg/ 1.35m²), respectively. These results are in conformity with the results of Bhamburkar (1993).

Hence the present trial conveys that October 15 is the optimum time of transplanting with respect of Arka Niketan followed by N-53 for recording maximum yield under local agro - climatic condition of Bapatla.

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Influence of Microbial Amendments on The Effective Utilization of Residual Phosphorus Sources for The Growth of Pigeonpea

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ABSTRACT

A greenhouse study was conducted to determine the influence of microbial amendments on the effective utilization of residual P sources for the growth of pigeonpea. Inoculation of soil with *Glomus aggregatum* increased the per cent mycorrhizal colonization in roots of pigeonpea in soils with residual P sources of soluble P (SOP), Mussorrie Rock Phosphate (MRP), Udaipur Rock Phosphate (URP), Tricalcium Phosphate (TCP) and North Carolina Rock Phosphate (NCRP) irrespective of presence of phosphorus dissolving fungus, *Aspergillus awamori*. VAMF inoculation increased the mean number of trifoliate leaves and height of plants grown in soil with residual P sources of MRP, URP, NCRP and NOP. Significant increase in total plant biomass due to mycorrhizal inoculation was observed. The plants grown in soil with residual P source of SOP produced highest shoot dry weight, root dry weight and total biomass. Over all mycorrhizal inoculation could utilize residual P sources more effectively in the presence or absence of phosphorus dissolving fungal partner.

Key Words : Microbial Amendments, Residual, Pigeonpea, Phosphorus.

Phosphorus (P) is an essential constituent of nucleic acids and plays a vital role in photosynthesis, cell division and formation of Adenosine Triphosphate (ATP) etc. Pulse crops are known to have more phosphorus requirement than cereals. Phosphorus fertilizers applied to the soil in soluble forms are expensive and get fixed into the soil in unavailable forms by reacting with hydroxides of iron and aluminium (Sanchez and Uehara, 1980). It is economical to use sparingly soluble and less expensive phosphatic rock as P source for the crop production. Further, phosphatic fertilizers have the greatest residual value and P application remains effective in the soil for long time (Barrow, 1980). Vesicular - arbuscular mycorrhizal fungi (VAMF) live in symbiotic association with crop plants. VAMF are known to enhance plant growth by improved P uptake (Jeffries, 1987; Bethlenfalvay, 1992; Manjunath and Habte, 1988).

Phosphorus solubilizing microorganisms (PSMs) are known to solubilize the insoluble forms of P through the excretion of organic acids (Sperber, 1958). PSMs make available insoluble forms of P to the plants and enhance the plant growth through increased P uptake (Mohod *et al.*, 1991). These microorganisms have been shown to interact synergistically in influencing P uptake and growth of plants (Jones and Sreenivasa, 1992). Further, application of insoluble P sources will not elevate P concentration in the soil solution to the levels that would interfere with the function of either VAMF symbiosis or activity of PSMs. Information on proper utilization of residual P sources or from already present P in soil is highly essential to

Table 1 : The residual effect of different sources of P and inoculation of soil with *Glomus aggregatum* and *Aspergillus awamori* on plant height of pigeonpea

P Source	Plant Height at 55 DAP (cm/plant)*			
	-PDF		+PDF	
	-GA	+GA	-GA	+GA
NOP	53.7b	60.1a	53.2b	60.0a
SOP	76.3a	74.5a	74.1a	72.3a
MRP	53.2c	65.8ab	60.4b	66.4a
URP	51.3c	65.7a	58.4b	62.3ab
TCP	71.0a	71.2a	68.8a	72.0a
NCRP	51.6b	59.6a	54.1b	55.5ab

* Means followed by the same letter within a P source do not differ significantly at P=0.05 by DMRT.

DAP :	Days after planting
NOP :	No P amendment
SOP :	Soluble Phosphate
MRP :	Mussorrie Rock Phosphate
URP :	Udaipur Rock Phosphate
TCP :	Tricalcium Phosphate
NCRP :	North Carolina Rock Phosphate
GA :	*Glomus aggregatum*
PDF :	Phosphorus dissolving fungus

develop a long term P fertilizer management strategy. Therefore, the present investigation was made to determine the influence of dual inoculation of VAMF and phosphorus dissolving fungus (PDF) on the effective utilization of various residual P sources for the growth of pigeonpea.

MATERIAL AND METHODS

In order to study the residual effect of different P sources and inoculation of soil with VAMF and / or PDF on the growth of pigeon pea, a greenhouse experiment was conducted at the Department of Agricultural Microbiology, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra (G.K.V.K.) Campus, Banglore. For this experiment soil was collected from the previous experiment where soil was treated with different sources of P. In the previous experiment, an alfisol was collected from the uncultivated field at the Regional Research Station, G.K.V.K., Banglore. Soil was sieved through 4 mm sieve and mixed thoroughly to get homogeneous mixture. Calcium hydroxide was uniformly mixed at the rate of 1.0 g per kg of soil to raise the pH from 5.4 to 6.2 as at this pH P availability was known to be maximum (Sanchez and Uehara, 1980). Sources of P used in the earlier study were "not amended with P (NOP), Potassium dihydrogen phosphate (a soluble phosphate - SOP), Mussorrie rock phosphate (MRP), Udaipur rock phosphate (URP). Tricalcium phosphate (TCP), North Carolina Rock phosphate (NCRP)" with total P content of 22.8, 7.4, 8.1, 17.56 and 12.73 per cent, respectively. These P sources were sieved through 100 µm mesh sieve and uniformly mixed with the soil at the rate of 0.2 g/kg soil. Then these soil samples were subjected to six cycles of wetting and drying after the addition of P and raised the pigeonpea plants. In the current study

Table 2 : The residual effect of different sources of P and inoculation of soil with *Glomus aggregatum* and *Aspergillus awamori* on the number of trifoliate leaves in pigeonpea**

P Source	Mean number of trifoliate leaves / plant*			
	-PDF		+PDF	
	-GA	+GA	-GA	+GA
NOP	9.6b	10.9a	9.3b	10.3ab
SOP	14.4a	13.2a	13.8a	13.3a
MRP	9.6c	10.9a	10.3ab	10.8a
URP	9.8c	11.6a	9.2b	11.4a
TCP	12.9a	13.0a	11.9a	12.3a
NCRP	9.7b	11.0a	9.7b	10.8ab

* Means followed by the same letter within a P source do not differ significantly at P=0.05 by DMRT.

** The abbreviations used in the table are same as given in the table 1.

soil samples were collected from the above experiment to determine the residual effect of P sources. These soil samples were air-dried, crushed and sieved through 2 mm sieve to remove root - bits. Soil samples were replaced in respective pots and were subjected to 3 cycles of wetting and drying.

Inoculum preparation

(a) Mycorrhizal inoculum preparation

Pure culture of VAMF, *Glomus aggregatum* Schenck and Smith Emenal Koske was mixed with five Kg of sterilized sand. Maize (*Zea mays* L.) plants were used for the multiplication of VAMF. Maize plants were subjected to water stress twice during crop growth period as water stress is known to enhance VAMF spore production. After 90 days of plant growth, the bits of colonized roots of maize, extra-matrical spores and hyphal bits of VAMF and sand were saved as crude inoculum of *G. aggregatum.* This inoculum consisted of 1000 extramatrical spores per 100 g of inoculum. Inoculum of *G. aggregatum* was added at the rate of 25 g kg^{-1} soil and mixed throughly with soil samples.

(b) Preparation of Phosphorus Dissolving inoculum

Aspergillus awamori, a phosphorus dissolving fungus (PDF), was grown in potato dextrose broth. The fungal mat was washed with 100 µM $MgSO_4$ solution and was homogenized in a Sorvall - Omni - mixer at 3000 rpm for 5 minutes. Ten ml of this fungal suspension was added to the point of planting.

Seeds of pigeonpea, *Cajanus cajan* L. Mill. Sp. Cv. TTB-7 were surface sterilized for 10 minutes with 70 per cent alcohol and washed four times in sterilized water and were pre-germinated on water agar (0.9 per cent Agar). These pre-germinated seeds were planted at the rate of four seeds per pot and later thinned to two plants per pot.

There were 24 treatments resulting from factorial combination of six forms of residual P sources, two levels of VAMF (inoculated and

Table 3 : The residual effect of different sources of P and inoculation of soil with *Glomus aggregatum* and *Aspergillus awamori* on shoot dry weight of pigeo pea**

P Source	Shoot dry weight(g / plant)*			
	-PDF		+PDF	
	-GA	+GA	-GA	+GA
NOP	1.400b	1.864a	1.335b	1.802a
SOP	3.408a	3.452a	3.623a	3.383a
MRP	1.251c	2.261a	1.680b	2.232a
URP	1.189c	2.119a	1.557b	1.952a
TCP	2.353b	2.770a	2.561b	2.791a
NCRP	1.196c	1.840a	1.488b	1.767a

* Means followed by the same letter within a P source do not differ significantly at P=0.05 by DMRT.
** The abbreviations used in the table are the same as given in the Table 1.

Table 4 : The residual effect of different sources of P and inoculation of soil with *Glomu aggregatum* and *Aspergillus awamori* on root dry weight of pigeonpea**

P Source	Root dry weight(g / plant)*			
	-PDF		+PDF	
	-GA	+GA	-GA	+GA
NOP	0.332b	0.419a	0.326b	0.384a
SOP	0.514b	0.570a	0.577a	0.607a
MRP	0.290c	0.453b	0.340c	0.541a
URP	0.353b	0.453a	0.384b	0.487a
TCP	0.464b	0.499ab	0.460b	0.533a
NCRP	0.308c	0.461a	0.363b	0.511a

* Means followed by the same letter within a P source do not differ significantly at P=0.05 by DMRT.
** The abbreviations used in the table are same as given in the table 1.

uninoculated) and two levels of PDF (inoculated and uninoculated) and there were three replicates per treatment. The moisture content in pots was maintained at field capacity. Plants were grown for 55 days and measured the growth parameters like, number of trifoliate leaves, plant height, shoot dry weight, root dryweight and total plant biomass. Extent of VAM colonization in pigeonpea roots stained with acid fuchsin (Kormanik *et al.*, 1980) was determined by the gridline intersect method (Giovannetti and Mosse, 1980). Data were subjected to statistical analysis and treatment means were separated by Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Inoculation of soil with *Glomus aggregatum* significantly enhanced the mean number of trifoliate leaves and the height of pigeonpea plants. Among different residual P

TOTAL BIOMASS (g / PLANT)

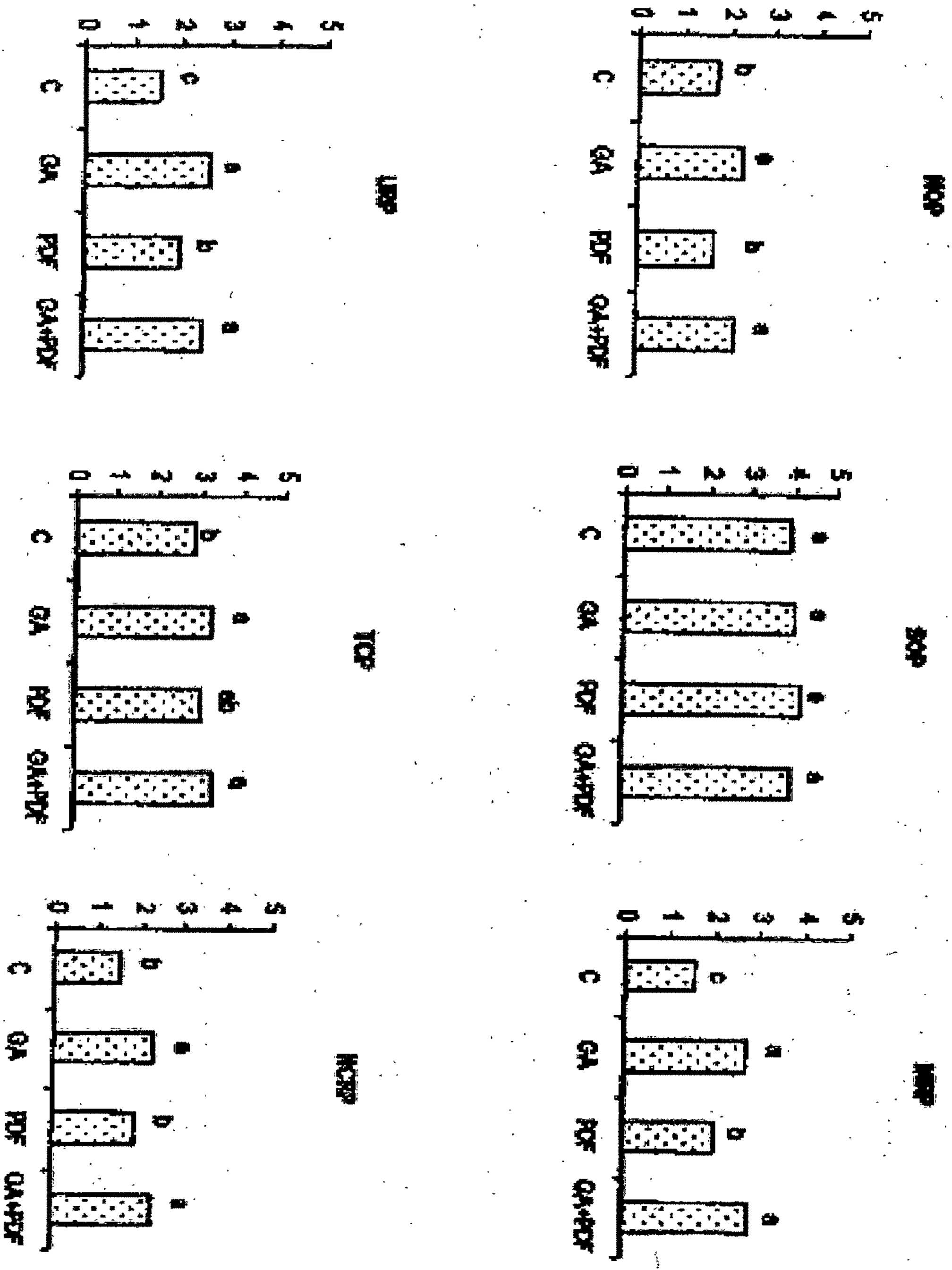

Fig. 1 The residual effect of different sources of P and inoculation of soil with *Glomus aggregatum* and *Aspergillus awamori* on total biomass of pigeon pea.

* Means with the same letter do not differ significantly at P = 0.05 by DMRT. NOP = No P amended, SOP = Soluble P (KH_2PO_4), MRP = Mussorrie Rock Phosphate, URP = Udaipur Rock Phosphate, TCP = Tricalcium phosphate, NCRP = North Carolina Rock Phosphate

C = Control, GA = *Glomus aggregatum*, PDF = Aspergillus awamori

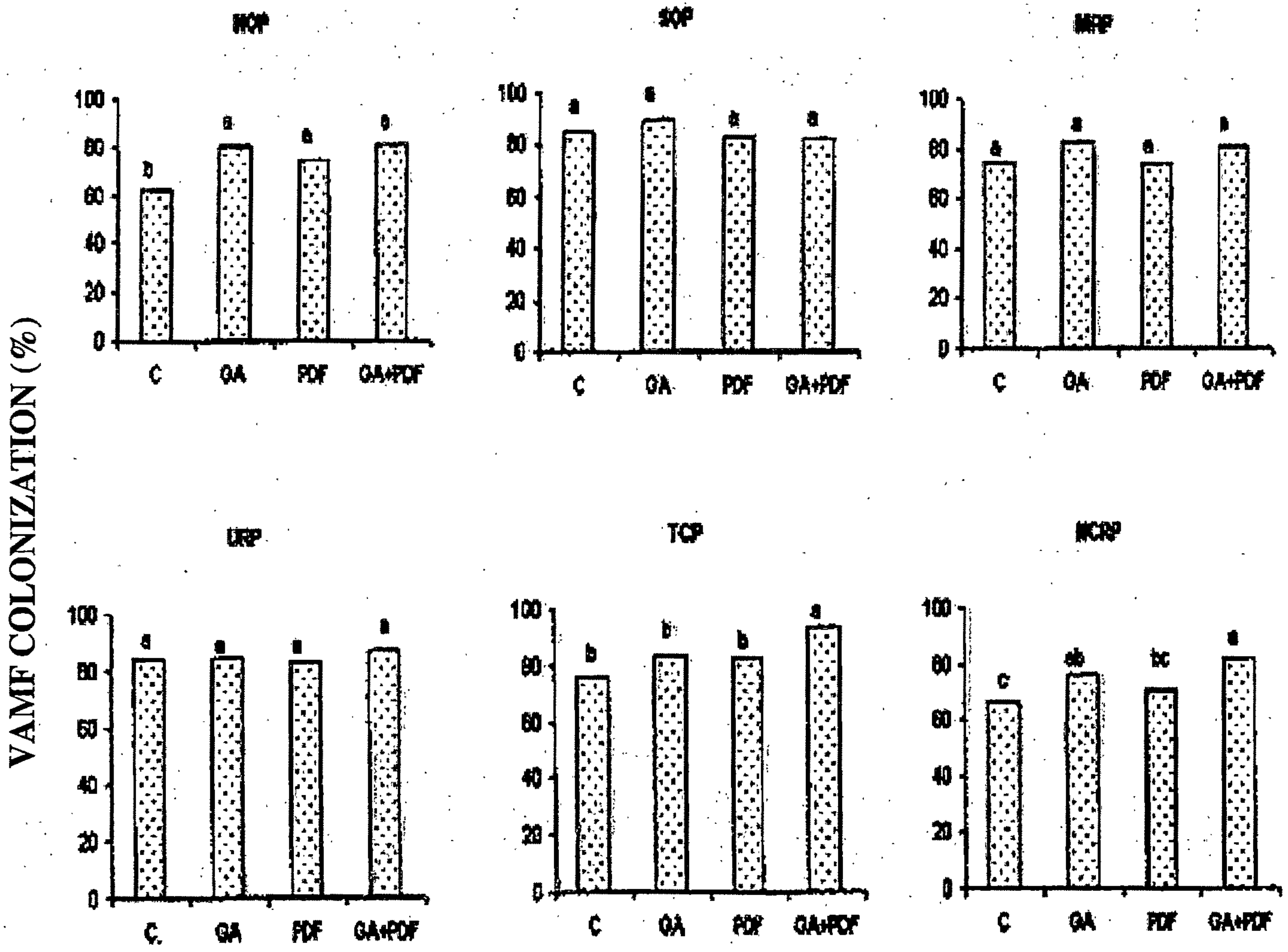

Fig. 2 The residual effect of different sources of P and inoculation of soil with *Glomus aggregatum* and *Aspergillus awamori* on mycorrhizal colonization in pigeonpea roots .

* Means with the same letter do not differ significantly at $P = 0.05$ by DMRT. NOP = No P amended, SOP = Soluble P (KH_2PO_4), MRP = Mussorrie Rock Phosphate, URP = Udaipur Rock Phosphate, TCP = Tricalcium phosphate, NCRP = North Carolina Rock Phosphate C = Control, GA = *Glomus aggregatum*, PDF = Aspergillus awamori

sources, plants grown in soil with residual SOP had maximum height and number of trifoliate leaves (Table 1 and 2). Inoculation of soil with VAMF increased the mean number of trifoliate leaves and height of plants grown in soil with residual P sources of MRP, URP, NCRP and NOP. Inoculation of soil with PDF alone did not significantly influence plant height. The microbial amendments could not influence significantly the height of plants grown in soils with residual P sources of SOP and TCP. Mycorrhizal inoculation significantly influenced dry weights of shoot, root and total biomass. The extent of increase was 22.6%, 25.2% and 22.9% with shoot dry weight, root dry weight and total biomass, respectively. Though the marginal increase in shoot and root dry weight was observed with PDF. inoculation the difference was not significant. The inoculation, of soil with PDF alone enhanced shoot dry matter of plants grown in soil with all the residual P sources except NOP. The plants grown in soil with residual SOP produced the highest shoot dry weight (3.466 g/plant), root dry weight (0.567 g/plant) and total biomass (4.034 g/plant) as compared to the other residual P sources (Tables 3 & 4 and Fig. 1). This effect may be due to the easy release of fixed forms of P of the SOP treatment into the soil solution.

Inoculation of *Glomus aggregatum* could influence total dry matter production in all the residual P sources except SOP (Fig. 1). The ranking of various residual P sources with respect to total biomass production was SOP > TCP > MRP > URP > NCRP > NOP (Fig. 1). Mycorrhizal inoculation caused significant increase in total biomass to the extent of 31%, 95%, 44%, 13% and 36% in the case of residuals of NOP, MRP, URP, TCP and NCRP, respectively. This beneficial effect due to inoculation of soil with *Glomus aggregatum* could be primarily due to the enhanced nutrient uptake (Jeffries, 1987; Bethlenfalvay, 1992; Manjunath and Habtle, 1988) and it could also be attributed to the uptake of diffusion limited nutrients such as P, Zn, Cu etc., (Manjunath and Habte, 1988; Pacovsky and Fuller, 1986; Lambert *et al.*, 1979). These results indicate that mycorrhizal inoculation can exploit very efficiently the phosphorus from various residual P sources in the presence or absence of phosphorus dissolving microorganisms.

Inoculation of soil with *Glomus aggregatum* enhanced the level of mycorrhizal colonization in roots of pigeon pea from 76.5% to 83.5% (Fig. 2). The presence of PDF did not influence the extent of root colonization by VAMF. Among different residual P sources, the level of VAMF colonization of plants grown in soil with residual SOP was maximum (85%). However, this value was not significantly different from that of levels noticed with plants grown in soil inoculated with *Glomus aggregatum* with marginally higher than those of plants grown in soil without VAMF inoculation irrespective of presence of PDF and P sources. A significant increase in the extent of root colonization by *Glomus agregatum* was noticed in soil with residual of SOP, URP and TCP. This could be due to low levels of P in soil, which enhances mycorrhizal colonization (Habte and Manjunath, 1987). The highest recorded colonization with residual SOP treatment might be responsible for obtaining the maximum growth yields in this treatment. These results indicate that VAMF inoculation leads to the utilization of residual P sources of the soil for better crop growth.

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Effect of Temperature and Relative Humidity on Collar Rot Infection of Groundnut

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ABSTRACT

Aspergillus niger infection increased with increase in temperature up to 35°C and beyond after which the disease showed a decline. It was also found that collar rot infection increased with increase in relative humidity. Maximum infection was recorded at 100 per cent relative humidity.

Key Words : Relative Humidity, Collar Rot Infection, Temperature, Groundnut.

Temperature and relative humidity (RH) are important environmental factors influencing the sporulation and multiplication of the pathogen and disease development. It is well documented that different host pathogen systems have different optimum temperatures and optimum RH for the infection to occur. Keeping this in view the present study was carried out to determine the effect of temperature and RH on the ability of *A. niger* to cause rotting of seed and seedling infection.

MATERIAL AND METHODS

Temperature Studies : Surface sterilized seeds of variety TMV - 2 were soaked in the conidial suspension of *A. niger* for 5 minutes and were later air dried. The inoculated seeds were tested for collar rot infection (both pre-emergence and post-emergence death) in separate seed germinators at different temperatures *viz.*, 20, 25, 30, 35, 40 and 45°C, respectively. The inoculated seeds were sown in plastic pots at the rate of four seeds per pot and each plastic pot was replicated five times for each treatment. The per cent seed germination and per cent collar rot infection were calculated using the formula.

$$\%\ \text{seed germination} = \frac{\text{No. of seeds germinated}}{\text{Total no. of seeds sown}} \times 100$$

$$\%\ \text{collar rot infection} = \frac{\text{No. of seedlings with collar rot infection}}{\text{No. of seedlings emerged}} \times 100$$

Relative Humidity Studies : The plastic pots sown with inoculated seeds were kept in separate desiccators maintained at different relative humidity levels *viz.*, 70, 80, 90 and 100 per cent as described by Buxton and Mellamby (1934). The desiccators were maintained in the laboratory at room temperature (28 ± 2°C) for 15 days. At the end of incubation per cent seed germination and per cent collar rot infection were calculated using the above formula. Four replications were maintained for each level of relative humidity.

Table 1 : Effect of Temperature on infection of groundnut seed by *Aspergillus niger.*

Temperature (°C)	Per cent seed germination*		Per cent reduction of germination over control	Per cent collar rot infection*
	Inoculated	Uninoculated control		
20	35.00	55.00	36.36	10.01
	(36.00)	(48.00)		(9.46)
25	45.00	65.00	30.77	20.01
	(42.00)	(56.89)		(18.34)
30	40.00	70.00	42.86	40.00
	(39.00)	(57.00)		(36.11)
40	30.00	55.00	45.45	50.00
	(33.00)	(39.00)		(45.00)
45	30.00	40.00	25.00	30.00
	(33.00)	(39.00)		(27.23)
SEM ±	3.35	5.62	-	15.60
CD (0.05)	9.79	16.41	-	45.54

* Mean of five replications

Figures in parenthesis are arc sine transformed values.

Table 2 : Effect of relative humidity on infection of groundnut seed by *Aspergillus niger.*

Temperature (°C)	Per cent seed germination*		Per cent reduction of germination over control	Per cent collar rot infection*
	Inoculated	Uninoculated control		
70	62.50	68.75	9.09	20.84
	(52.50)	(56.25)		(20.35)
80	31.25	62.50	50.00	37.50
	(33.75)	(52.50)		(33.89)
90	31.25	56.25	44.44	62.50
	(33.75)	(48.75)		(56.11)
100	25.00	37.50	33.33	74.99
	(30.00)	(37.50)	-	(64.21)
SEM ±	3.42	4.05	-	12.94
CD (0.05)	10.55	12.48	-	41.50

* Mean of five replications

Figures in parenthesis are arc sine transformed values.

RESULTS AND DISCUSSION

Temperature Studies : From the Table 1 it can be observed that reduction in seed germination over control was maximum (61.01%) when seeds were incubated at 35°C followed by 45.5 per cent at 40°C, 42.86 per cent at 30°C, 36.36 per cent at 20°C, 30.77 per cent at 25°C and 25.00 per cent at 45°C. It is interesting to observe that collar rot infection showed a decline when the temperature was either increased above or decreased below 35°C. The findings of the present study are in conformity with the findings of Jackson (1965), Gibson (1953) and Bell (1969). These findings suggest that 35°C is the optimum temperature for *A. niger* to infect groundnut seed causing pre-emergence rotting of seed and collar rot infection.

Relative humidity studies : In the study it was clear from Table 2 that increase in relative humidity was found to increase the infection. A 50.00 per cent reduction in seed germination was observed at 80 per cent RH followed by 44.00 per cent at 90 per cent RH. However, maximum collar rot disease (74.99%) was recorded at 100 per cent RH. The results in the present study indicated that 80 per cent RH is the optimum for *A.niger* to multiply and cause reduction in seed germination. The findings of the present study are in agreement with the reports of Gibson (1953) and Dange and Patel (1984).

From the present study, it can be concluded that temperature of 35°C and relative humidity of 80 per cent are optimum for the pathogen to cause maximum losses in groundnut.

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Management of Tomato Mosaic Disease

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ABSTRACT

An investigation was carried out on the management of tomato mosaic disease under field conditions. Three insecticides *viz.*, Monocrotophos, Endosulfan and Dimethoate, two viricides *viz.*, Virex-H and Action-100 and two leaf extracts Neem and Bougainvillea were tested. Among the insecticides, viricides and leaf extracts Monocrotophos (0.1%) was the most effective which not only kept the vector populatin low (3.66) but also helped in low disease incidence (28.38%) accounting for 32.93 per cent inhibition of disease over control. Dimethoate was the next best insecticide. None of the leaf extracts were effective in reducing the disease and vector population.

Key Words : Bougainvillea, Mosaic, Tomato, Insecticides, Viricides.

Tomato is one of the most important and subsistence vegetables grown in Karnataka occupying an area of 22,808 ha with a production of 2,59,357 tonnes (Anno. 1997). Though among all viral diseases tomato leaf curl and tomato mosaic are destructive in India (Saikia and Muniyappa, 1989), tomato mosaic disease is becoming disastrous in recent years and taking a heavy toll of the crop yield.

One of the useful ways for the management of various virus diseases is by the control of vector population by using systemic insecticides. Earlier reports revealed that use of systemic insecticides, viricides and leaf extracts was effective. Hence the present investigation was undertaken to see the efficacy of insecticides, viricides and leaf extracts in the control of vector and there by reducing the disease incidence.

MATERIAL AND METHODS

A field experiment to evaluate the efficacy of three insecticides *viz.*, Monocroptophos (0.1%), Endosulfan (0.25%) and Dimethoate (0.175%), viricides *viz.*, Vire - H (2%) and Action - 100 (2%) and leaf extracts Neem(10%) and Bougainvillea (10%) against tomato mosaic disease was conducted during *Kharif* 2000 at University of Agricultural Sciences, Dharwad. All these insecticides, viricides and leaf extracts were sprayed at 10,25 and 40 days after transplanting. Observations were recorded on incidence of disease and vector population at 10, 25 and 40 days after transplanting. The data were analysed statistically. The per cent disease inhibition over control was calculated by using the formula given by Vincent (1927).

$$I = \frac{C - T}{C} \times 100$$

Where,

I = Per cent inhibition
C = Per cent disease in control
T = Per cent disease in treatment

Table 1 : Evaluation of insecticides, viricides and plant extracts for the management of tomato mosaic disease

Treatments	10 DAT		25 DAT		40 DAT		55DAT			
	Per cent disease incidence	Aphid number per leaf	Per cent disease incidence	Aphid number per leaf	Per cent disease incidence	Aphid number per leaf	Per cent disease incidence	Aphid number per leaf	Mean per cent disease incidence	Per cent disease inhibition
Monocrotophos	8.22 (16.661)*	2.71	30.39 (33.45)	3.22	36.94 (36.87)	3.43	37.90 (37.99)	3.66	28.36	32.95
Endosulfan	9.75 (18.19)	3.62	35.58 (36.61)	5.67	33.50 (38.35)	8.33	42.60 (40.74)	10.82	31.61	25.27
Dimethoate	8.96 (17.41)	2.38	33.44 (35.32)	3.33	38.64 (38.43)	5.58	40.56 (39.55)	8.24	30.40	28.13
Neem	10.59 (18.99)	6.28	42.49 (40.68)	8.66	47.51 (43.57)	12.46	50.49 (45.28)	14.33	37.77	10.70
Bougainvillea	12.30 (20.53)	8.34	44.59 (41.89)	13.75	52.15 (46.23)	16.67	54.87 (47.45)	19.42	40.98	3.12
Virex - H	9.89 (18.33)	5.33	36.46 (37.14)	9.48	41.29 (39.98)	10.22	46.47 (42.97)	12.32	33.53	20.73
Action - 100	9.69 (18.13)	4.20	36.43 (37.14)	8.21	38.52 (38.36)	10.34	42.29 (40.56)	11.23	31.73	24.98
Control	12.97 (21.10)	11.12	45.77 (42.57)	14.32	53.63 (47.08)	18.67	56.82 (48.92)	21.62	42.30	-
S.Em ±	0.584	0.288	0.722	0.542	1.489	0.736	1.014	0.558	-	-
CD at 5%	1.772	0.872	2.193	1.644	4.516	2.232	3.077	1.693	-	-

* Figures in parenthesis indicate arc sine values DAT - Days after transplanting

RESULTS AND DISCUSSION

The data presented in Table 1 revealed that among the insecticides, viricides and leaf extracts sprayed at 15 days interval Monocrotophos (0.1%) was the most effective which not only kept the vector population low (3.66), but also helped in reducing disease incidence (28.36%) accounting for 32.95 per cent inhibition of disease over control. Dimethoate (0.175%) was the next best insecticide, which accounted for reduction of the disease to a tune of 28.13 per cent over control. These results are in accordance with reports of Rao and Reddy (1983) and Singh *et. al.*, (1978) who reported control of aphids by spraying systemic insecticides like Monocrotophos, Dimethoate, Methamidophos and Oxydemeton methyl and consequently, reduction in the incidence and spread of mosaic disease of soybean and in turn reducing the incidence and spread of mosaic disease of soybean.

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Effect of Waterlogging and Foliar Nutrition on Groundnut (*Arachis hypogaea L.*)

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ABSTRACT

The effect of waterlogging and foliar sprays on plant height, leaf area, No. and fresh wieght of nodules, stomatal conductance, relative water content and pod yield was investigated at different time intervals in a pot culture experiment conducted at Agricultural College, Bapatla during *rabi* 2001. Waterlogging was imposed from 20 to 30 DAS and 50 to 60 DAS. Five foliar sprays were given after alleviating waterlogging *viz.*, (i) water (ii) Urea (0.5%), (iii) Urea (0.5%) + Sucrose (0.25%) (iv) Urea (0.5%) + K_2SO_4 (0.25%) and (v) Urea (0.5%) + Sucrose (0.25%) + K_2SO_4 (0.25%). Besides these control plants were maintained without waterlogging and without foliar sprays. At every stage, control had maximum values indicating that waterlogging was detrimental to growth though supplemental nutrition through foliar sprays were given. Among foliar sprays maximum pod yield was found in Urea and Potassium sulphte.

Key Words : Waterlogging, Foliar Nutrition, Groundnut, Urea, Sucrose, Potassium Sulphate.

India is one of the leading oilseed producing countries and groundnut occupies first place among oilseed crops having about 50 per cent edible oil and 35 per cent protein. In coastal sandy loams of Andhra Pradesh, groundnut crop undergoes unscheduled heavy rains leading to water logging condition which set back the plant growth and results in lower yields. Therefore, for increasing its productivity attention is to be paid. However, information on foliar sprays after waterlogging condition is lacking. In this context five foliar sprays are given to facilitate quick recovery from waterlogging. Keeping this in view, the present study was taken up to know the effect of waterlogging and foliar sprays on the recovery of groundnut crop.

MATERIAL AND METHODS

A pot culture experiment was conducted on the effect of waterlogging and foliar sprays in groundnut cultivar TMV - 2 in factorial RBD with single control replicated 6 times. Two sets of groundnut plants with control plants without waterlogging and without foliar sprays were taken. One set was grown under waterlogging from 20 to 30 DAS and the another set was from 50 to 60 DAS. Five foliar sprays *viz.,* (i) water (ii) Urea (0.5%), (iii) Urea (0.5%) + Sucrose (0.25%) (iv) Urea (0.5%) + K_2SO_4 (0.25%) and (v) Urea (0.5%) + Sucrose (0.25%)+ K_2SO_4 (0.25%) were given for both sets after alleviating waterlogging. Plant height (cm); No. and fresh weight of nodules (g) per plant; leaf area (cm^2) / plant ; relative water content (%); stomatal conductance (cm s^{-1}); and pod yield(g) / plant were observed. Leaf area (cm^2) was recorded by leaf area meter and stomatal conductance (cm s^{-1}) was estimated with porometer. All observations were recorded at the time of harvest to predict their effects on final yield.

Table : Effect of water logging and foliar sprays on Groundnut

Treatment		Plant height (cm)	No. of nodules	Wt. of nodules (g)	Leaf area /plant (cm²)	RWC	Stomatal conductance (cm s⁻¹)	Pod yield/plant (g)
Control		18.9	82.1	111.6	238.0	83.2	19.6	34.3
	Water	16.8	75.0	104.9	226.6	82.7	16.8	25.9
Water logging	Urea (0.5%)	18.6	79.5	107.6	234.6	81.9	17.7	30.4
from 20 to 30	Urea (0.5%) + Sucrose (0.25%)	18.5	79.8	107.5	207.6	81.6	18.4	31.3
DAS + Foliar	Urea (0.5%) + K_2SO_4 (0.25%)	17.7	80.3	108.1	205.6	81.4	19.3	34.2
spray of	Urea (0.5%) + Sucrose (0.25%) + K_2SO_4 (0.25%)	18.3	80.0	103.6	204.3	81.1	17.6	31.7
	Water	16.3	76.1	104.6	207.0	82.2	18.7	24.3
Water logging	Urea (0.5%)	16.1	77.1	105.5	216.6	81.7	18.7	26.2
from 50 to 60	Urea (0.5%) + Sucrose (0.25%)	16.6	77.1	105.8	213.3	81.4	18.8	29.5
DAS + Foliar	Urea (0.5%) + K_2SO_4 (0.25%)	17.4	77.3	105.1	205.6	81.2	18.6	23.1
spray of	Urea (0.5%) + Sucrose (0.25%) + K_2SO_4 (0.25%)	17.9	77.6	107.5	204.3	81.5	19.0	29.8
CD (0.05%)		0.6	3.5	3.9	1.9	1.1	1.7	2.4
Water logging from 20 to 30 DAS		17.8	78.9	107.1	221.8	81.7	18.27	30.7
Water logging from 50 to 60 DAS		16.8	77.1	104.9	209.6	81.6	17.24	28.8
CD (0.05%)		0.2	--	2.8	5.3	1.8	2.7	3.7
Foliar spray of water		16.1	75.5	104.2	215.5	82.4	18.6	25.1
Foliar spray of Urea (0.5%)		17.4	78.5	106.4	220.8	81.8	18.6	28.3
Foliar spray of Urea (0.5%) + Sucrose (0.25%)		17.6	78.5	106.1	225.6	81.5	18.6	30.5
Foliar spray of Urea (0.5%) + K_2SO_4 (0.25%)		17.6	78.8	107.1	210.5	81.3	18.6	32.0
Foliar spray of Urea (0.5%) + K_2SO_4 (0.25%)		18.1	78.9	106.3	205.6	81.1	19.2	26.6
CD (0.05%)		0.4	1.9	0.6	2.1	0.6	1.093	1.7

RESULTS AND DISCUSSION

Plant height (cm)

The maximum plant height was found in control (18.9 cm) followed by foliar spray of urea + sucrose (18.6 cm) in waterlogged plants from 20 to 30 DAS. (Table). Waterlogging from 20 to 30 DAS was found less detrimental to growth. Among foliar sprays, foliar spray of urea + sucrose and urea + sucrose + potassium sulphate were on par with each other. Similar results were reported by Bishnoi and Krishnamoorthy (1995). This might be due to the synergistic effect of energy from sucrose and essential elements from urea and potassium sulphate.

Number and weight of nodules per plant

The number and fresh weight of nodules differed widely in control and rest of the treatments. The maximum No. and weight of nodules was found in control (82.1 and 111.6 g, respectively) followed by foliar spray of Urea + potassium sulphate (80.3 and 108.1 g, respectively). Foliar sprays after removal of waterlogging did not increase the No. of nodules per plant. In waterlogged condition the reduced root growth particularly loss of root hairs was found inevitable which reduced nodule initiation (Minchin *et al.*, 1977). Sprent (1976) also reported that anaerobic condition inhibited nodulation in legumes.

Leaf area per plant (cm^2)

Being indeterminate crop, leaf area gradually increase upto harvest but due to senescence of older leaves at harvest slight decrease in leaf area was observed. However maximum leaf area was observed in control (238 cm^2) followed by foliar spray of urea + sucrose (234.6 cm^2) in 1st set of waterlogging plants. Waterlogging reduced leaf area significantly and waterlogging from 20 to 30 DAS was found less detrimental. Waterlogging from 20 to 30 DAS decreased the leaf area to an extent of 7.8 per cent over the control whereas waterlogging from 50 to 60 DAS decreased the leaf area to an extent of 13.1 per cent. These results are in accordance with the findings of Weijun Zhou and Lin (1995).

Stomatal conductance (cm s^{-1})

Waterlogging reduced the stomatal conductance significantly. Control had the maximum stomatal conductance (19.6 cm s^{-1}) followed by foliar spray of urea + potassium sulphate (19.3 cm s^{-1}) in waterlogging from 20 to 30 DAS. Foliar sprays in waterlogging from 50 - 60 DAS did not differ with reference to the stomatal conductance. Waterlogging from 50 to 60 DAs was found less deleterious than waterlogging from 20 to 30 DAS. Foliar spray of urea + sucrose + potassium sulphate had augmented stomatal conductance. Probably the element potassium in potassium sulphate might have increased the stomatal conductance as it had a crucial role in stomatal closing and opening. During recovery phase, control plants showed very low stomatal conductance (Incoll and Whitelam, 1977).

Relative water content (RWC) (%)

The response of waterlogging on RWC varied widely. Control plants recorded maximum RWC (83.2) followed by foliar spray of water in waterlogging from 20 - 30 DAS (82.7). In waterlogging from 50 - 60 DAS, RWC decreased. It indicates the foliar spray of water augments the RWC. Thus RWC of leaves increased with the duration of waterlogging period at initial stage of the crop. (Das *et al.*, 2000).

Pod yield (g) / plant

The pod yield of the control and rest of the treated plants differed significantly. Waterlogging reduced the pod yield per plant. Waterlogging from 20 to 30 DAS was less detrimental. The response of different foliar sprays was alike in influencing pod yield / plant. However the maximum yield was found in control (34.3g) followed by foliar spray of urea + potassium sulphate in the 1st set waterlogged plants (34.2g). Present results are similar to the findings of Chol *et al.* (1986) in groundnut.

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Influence of Receeding Soil Moisture on Morphological Parameters of Blackgram

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ABSTRACT

A field experiment was conducted during *rabi* season 1998-99 with split plot design with irrigation and no irrigation as main plots and blackgram genotypes (LBG-623, LBG -20, WBG-26, T9, MBG-207 and MBG-201) as sub plots to study the influence of receding soil moisture on morphological parameters of blackgram genotypes. Results indicated that, under receding soil moisture conditions blackgram genotypes exhibited reduction in morphological parameters like plant height, No. of leaves, leaf area, leaf area index, total plant dry matter due to which considerable yield reduction was observed. Among all the genotypes LBG-20 showed less reduction under moisture stress conditions and showed its genetic superiority.

Key Words : Morphological Parameters, Soil Moisture, Blackgram, Genotype.

Pulses are inevitable in Indian Agriculture as they play major role in vegetarian diet to meet the protein requirement. Pulse productivity is very low inspite of their requirement as they are grown on marginal and sub marginal lands and confined to traditional farming. The present pulse demand is 24 million tonnes but the production is only 18 million tonnes.

Blackgram is an improtant pulse crop in Andhra Pradesh which occupied 5.45 lack ha with the productivity of 585 kg ha^{-1}. Most of the crop is grown in *rabi.* Krishna and Guntur districts in Andhra Pradesh account for more than 70% of area in the state under blackgram. Guntur district alone claims 37 per cent and 40 per cent of the State total area and productivity respectively. Considerable yield reduction was observed in this crop as it is grown during post monsoon season when the soil moisture is a limiting factor for growth.

MATERIAL AND METHODS

A study was carried out at Agricultural College Farm, Bapatla during *rabi* season of 1998 - 99. The experiment was designed in split plot layout with four replications; irrigation and no irrigation as main plots and blackgram genotypes as sub plots. The blackgram genotypes used for the study are : LBG-623, LBG -20, WBG-26, T9, MBG-201 and MBG-207. A basal dose of 20 kg N and 50 kg P_2O_5 was incorporated in to the soil before sowing. All the plots were given pre-sowing irrigation to get uniform germination. At 33 DAS one set of plots was irrigated and the other set was not irrigated.

Soil moisture was recorded at weekly intervals gravimetrically at two depths i.e., 15 - 30 cm and 30 - 45 cm. Plant height, No. of leaves, leaf area, leaf area index and total plant dry matter were recorded at weekly intervals.

Table 1 : Effect of moisture stress on morphological parameters in Blackgram at 54 DAS

Genotype	Plant height (cm)		No. of leaves (No.)		Leaf area (cm^2)		LAI (Ratio)		Total plant dry matter (g/plant)	
	I	D	I	D	I	D	I	D	I	D
LBG - 623	24.8	14.0	14.9	4.7	843	186	2.81	0.62	5.48	2.83
LBG -20	22.8	12.1	13.9	4.7	831	213	2.77	0.71	5.18	3.13
WBG-26	17.0	11.3	13.3	4.2	675	156	2.25	0.52	4.73	2.60
T9	16.0	10.3	13.4	3.8	624	150	2.08	0.56	4.55	2.26
MBG-207	21.8	11.6	13.6	4.4	864	195	2.89	0.65	5.45	3.03
MBG-201	23.0	13.2	14.2	5.0	870	195	2.92	0.65	5.50	3.03
M	0.56		0.53		42.5		0.17		0.96	
S	0.70		0.43		34.7		0.82		0.11	
SXM	1.00		0.57		45.2		0.02		0.10	
CV(%)	4.26		4.36		14.04		5.73		5.47	

I = Irrigation D = Drought (Moisture stress)

RESULTS AND DISCUSSION

The treatment was imposed at 33 DAS i.e., at 50% depletion of soil moisture i.e., one more irrigation was given as a treatment at 33 DAS in addition to pre-sowing irrigation and no irrigation was given to another set of plots and crop was exclusively grown on receeding soil moisture. There was no rain during crop growth period which enabled the conduct of experiment successfully.

Plant height was reduced significantly by soil moisture stress in all the stages during crop growth period (Table 1). Similar reduction in plant height was observed in cotton (Shimshi and Marani, 1970) and in greengram (Varugheese and Irutharaj 1993). The differences in the rate of increase in plant height between irrigated and drought treatments as well as among genotypes might be due to differences in relative water content of leaves which is essential for maintenance of turgor pressure for stem elongation and cell division. Leaf number was reduced under moisture stress conditions. Similar results were reported in soybean (Frederic, 1988). Leaf area and leaf area index were also reduced significantly under moisture stress conditions compared to irrigated treatment which might be due to less elongation and enlargement of cells; as cell elongation is turgor dependent phenomenon, coupled with lower photosynthetic rate (Sung and Kreig, 1979) the genotype LBG - 20 recorded maximum leaf area and T9 recorded minimum.

Total plant dry matter is the most relevant parameter to express growth. The dry matter accumulation was significantly reduced under moisture stress as water stress usually affects both stomatal conductance and photosynthetic activity. The results are in confirmity with the findings of Lee (1971) on Pea. Similar reduction in dry matter accumulation in sunflower heads was reported by Rao *et al.* (1987). Higher dry matter reduction observed at flowering and pod formation stages can be attributed to high water requirement of blackgram during these stages. Similar observations were recorded by Lin *et al.* (1963), Chen *et al.* (1964) and Lingam (1969) in groundnut.

Table 2 : Effect of moisture stress on yield and yield components of blackgram

Genotype	No. of pods / plant		No. of seeds / pod		Test weight (g/1000)		Yield (kg ha^{-1})	
	I	D	I	D	I	D	I	D
LBG - 623	19.9	8.3	4.0	2.9	47.3	44.2	1350	434
LBG -20	15.9	9.9	3.6	3.3	46.5	43.7	1182	530
WBG-26	13.3	7.5	3.3	2.6	40.4	37.1	1108	301
T9	13.0	7.1	3.2	2.2	39.4	36.3	1025	289
MBG-207	17.2	8.3	3.6	3.0	41.1	38.2	1189	452
MBG-201	18.4	8.5	3.7	3.2	42.5	39.8	1196	482
M	0.49		0.08		0.13		16.7	
S	0.55		0.06		0.42		19.1	
SXM	0.78		0.08		0.60		26.3	
CV(%)	4.40		1.84		1.03		2.29	

I = Irrigation D = Drought (Moisture stress)

Plant height, leaf number, leaf area, leaf area index and total plant dry matter, which were reduced greatly under moisture stress conditions in turn effected the yield components and ultimately the yield.

Yield components like number of pods/ plant, number of seeds/ pod and test weight were significantly less under moisture stress than irrigated condition due to less leaf number, leaf area and total plant dry matter (Table 2). Genotypic differences were also observed in yield components, more number of pods/plant and more number of seeds / pod were recorded by LBG - 20 which maintained the highest leaf number, leaf area and total plant dry matter which might be due to the genotypic efficiency to translocate more photosynthates into the reproductive parts.

The phloem transport is turgor dependant process and ability to continue to translocate carbon is a key factor virtually in all aspects of plant tolerance to drought. Similar observations were repoted in mungbeen (Daulay *et al.*, 1978) and in soybean (Bartler and Caesor, 1987).

Grain yield was recorded maximum in LBG - 20 under receding soil moisture, mainly contributed by maximum No. of pods/plant, No. of seeds / pod and test weight which were mainly supported by No. of leaves, leaf area and total plant dry matter. By this it can be concluded that the genotypes which maintain high tissue water content under moisture stress can maintain better morphological parameters and ultimately yield components and yield.

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Export Performance of Turmeric - An Application of Markov Chain Model

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ABSTRACT

This study was undertaken to examine the proportion of turmeric exported by India to different countries over a period of time and the changing pattern of trade among different countries. Analysis of direction of trade showed that UAE was the major importer of Indian turmeric followed by USA and the quantity of the turmeric export to each of the selected six importing countries has shown a marked incline. If the present trade were to continue the total value of exports would touch a high of 76.20 crores by the year 2010 A.D. from the present export value of 15.24 crores.

Key Words : Export, Markov Chain Model, Turmeric, Trade.

India has got a well-known reputation as a land of spices from times immemorial. It is the largest producer, exporter and consumer of spices, besides export domestic consumption in our country is also steadily increasing day - by - day. Spices are grown in about 23 lakh hectares of land with a production of about 25 lakh tones every year. Among the spices, turmeric is one of the most important and ancient spices of India and also a traditional item of export. It is extensively used in preparation of tasty curried dishes by all people for its typical flavour and colour. It is also used as dye in certain cotton textiles, in medicine and cosmetics (Ridly 1983). Cultivation of turmeric offers considerable scope for rural employment and foreign exchange earnings. India is the largest producer and exporter of turmeric in the world with an annual production of 4.87 lakh tones (1997 -1998), mainly in Andhra Pradesh, Maharashtra, Orissa, Tamilnadu, Karnataka and West Bengal. The value of exports in turmeric had increased from Rs. 1939.28 lakhs in 1989-90 to Rs. 12454.98 lakhs in 1998 - 99. However no specific effort has been made to enhance the dynamics of change in exports. With this backdrop, an attempt is made here to examine the changing structure of Indian turmeric exports in order to have better insight into the dynamics of the changes.

METHODOLOGY

To study the export performance of turmeric, six major turmeric importing countries *viz.*, UAE, USA, UK, Iran, Bangladesh and Japan were identified. The export performance was studied by using the Markov Chain Analysis.

Markov Chain Analysis

The structural change in the share of export of turmeric was analyzed through a first order Markov model by examining gains and losses in export share of Indian turmeric by major importing countries. In the context of current application, six major importing countries of turmeric *viz.*, UAE, USA, UK, Iran, Bangladesh and Japan were identified. The average export to a particular country was considered to be a

Table 1 : Transitional probability matrix of turmeric exports

Importing Countries	UAE	USA	UK	Iran	Bangladesh	Japan
UAE	0.3432	0.1880	0.2537	0.0000	0.0000	0.2151
USA	0.5327	0.0000	0.2417	0.0000	0.0000	0.2256
UK	0.0000	0.8485	0.0000	0.0000	0.1515	0.0000
Iran	0.0941	0.0137	0.0142	0.4548	0.2253	0.1979
Bangladesh	0.0000	0.0000	0.0000	0.7162	0.2838	0.0000
Japan	0.6838	0.2108	0.0000	0.0000	0.1054	0.0000

random variable following a first order Markov process.

$$Ejt = E_{it}\text{-}1\ pij + ejt$$

where

E_{jt} = Exports from India during the year 't' to j_{th} country.

E_{it}-1 = Exports to i^{th} country during the period t-1

pij = Probability that exports will shift from i^{th} country to j^{th} country.

ejt = The error term which is statistically independent of E_{it-1} and

r = Number of importing countries

The transitional probability pij, which can be arranged in a (cxr) matrix, has the following properties.

$$O \leq P_{ij} \leq 1$$

$$\Sigma P_{ij} = 1 \text{ for all i}$$

The diagonal elements of the matrix P indicate the probability that the export share of a particular country will remain the same from one period to another. The off diagonals of transfer probabilities indicate the probability that the share of exports in a particular country will shift change to another country over period of time. Thus the export share of a country during the period t was obtained by multiplying the actual exports in the previous period (t-1) by the transitional probability matrix.

Lee *et al.* (1965) and Veena *et al.* (1994) used the Linear Programming frame work by a method referred to as minimization of Mean Absolute Deviation. (MAD) to estimate the transitional probability matrix.

$$\text{Min } OP^* + Ie$$

subject to

$$XP^* + v = Y$$

$$GP^* = 1$$

$$P^* \geq 0$$

where

P* is a vector in which probability Pij are arranged

O is vector of zeros

I is an appropriately dimensioned vector of area

e is the vector of absolute errors (IUI)

y is the vector of export to each country,

x is a block diagonal matrix of lagged values of y and v is the vector of errors

G is a grouping matrix to add the row elements of P, arranged in P* to unity.

RESULTS AND DISCUSSION

Direction of Export

The transitional probability matrix obtained by using linear programing is presented in Table 1. It could be observed that Iran and UAE had a higher retention of the export share. In other words, the probability of Iran and UAE to retain their import shares in the years to come are estimated to be 0.4548 and 0.3432 which clearly indicated that these two countries would retain their share in the same position in 1999 - 2000 also. Bangladesh could also be included in this list. These results are in conformity with the findings of Ajjan *et al.* (1998) and Disney *et al.* (1988).

Using the transitional probability matrix, absolute quantities and market shares of turmeric exports to major importing countries were projected up to 2010 AD. The actual and estimated quantities and percentage of turmeric export are given in Table 2 and 3. UAE was the major importer of Indian turmeric. It's share in total export varied widely between 23 per cent in 1997 - 98 and about 47 per cent in 1989 - 90. The next major buyer was USA whose share varied between 16.76 per cent and 32 per cent (Table 2). The reason attributed to this wide fluctuations was purely based on the demand of the importers. After 1999, it was observed that, UAE could retain nearly 29-32 per cent of the total turmeric exports, that UAE is considered to be a growing market importing about a value of 24 crores (31.64%) in 2010 A.D. The other major buyers are USA, Japan, Iran and UK. The reduction in value of exports to Bangladesh may be attributed to strict enforcement of standards and there by exports to the country shall be reduced. The higher retainability of share in future by UAE might be attributed to their well - developed technology for extraction of oleoresin and availability of ready market for their product.

But what is alarming is that despite the changes taking place in export shares, the over all size of the Indian exports is increasing. The results indicated that the quantum of export to each of these markets have shown a marked incline if the present trade were to continue the total value of exports would touch a high of 76.20 crores by the year 2010 AD from the present export value of 15.24 crores (Table 3).

India is the leading producer and supplier of turmeric in the World. India enjoys a monopoly position with a share of 90 per cent in the international trade for turmeric. However, China, Peru and Thailand are emerging as stiff competitors in the recent years. It has been reported that Thailand has turmeric varieties with curcumin content of 6 per cent. This will certainly erode a proportion of our market share. Hence, we should take efforts to retain our monopoly position in future by updating our cultivation practices including development of high curcumin varieties.

Conclusion

The export of turmeric is highly unstable; also it is confined to a few countries only. Thus the future prospects depend upon the demand pattern of these countries only. UAE is the major buyer of Indian turmeric, while USA seems to be a growing market for turmeric.

Policy Implications

It is clear that the market for Indian turmeric is confined to few countries only which could be strengthened further to retain their share. Besides necessary steps need to be taken to explore new markets in order to augment the foreign exchange earning. In order to reduce the cost of production and to increase profits to growers, resources and inputs are to be managed and used judiciously. The latest agro-techniques are to be followed. Storage

Table 2 : Actual and estimated turmeric exports to different countries (1989 - 90 to 1998 -1999) (Rs. 000')

Year	UAE		USA		UK		Iran		Bangladesh		Japan		Total	
	A	E	A	E	A	E	A	E	A	E	A	E	A	E
1989-90	51307.38	54014.53	22649.58	33659.68	18631.92	25482.40	2444.70	6444.33	1049.22	7977.50	12399.20	24815.11	108482.00	152393.20
	(47.30)	(35.44)	(20.92)	(22.09)	(17.15)	(16.72)	(2.25)	(4.23)	(1.00)	(5.23)	(11.44)	(16.29)	(100.00)	(100.00)
1990-91	14517.60	38382.67	30021.44	63606.83	19934.56	18525.76	932.88	1863.30	4294.56	4978.16	23921.84	16629.73	93622.88	143986.45
	(15.50)	(26.66)	(32.00)	(44.18)	(21.30)	(12.87)	(1.00)	(1.29)	(4.60)	(3.45)	(25.60)	(11.55)	(100.00)	(100.00)
1991-92	81803.54	37420.34	53979.49	24699.23	26578.13	10952.53	5005.80	3499.96	15238.70	6970.37	22041.48	10080.17	204647.14	93622.60
	(40.00)	(39.97)	(26.30)	(26.38)	(13.00)	(11.70)	(2.40)	(3.74)	(7.50)	(7.44)	(10.80)	(10.77)	(100.00)	(100.00)
1992 -93	119959.00	72372.74	58031.66	42645.48	37880.80	33871.45	8517.96	13190.60	16472.00	11802.30	44753.18	30764.33	285614.60	204646.90
	(42.00)	(35.56)	(20.00)	(20.84)	(13.30)	(16.55)	(3.00)	(6.45)	(6.00)	(5.77)	(15.70)	(15.03)	(100.00)	(100.00)
1993 -94	112103.00	103487.07	67105.30	64244.80	46570.70	44580.80	20894.40	15671.20	17811.30	17049.75	33900.20	40580.80	298384.90	285614.42
	(37.60)	(36.23)	(22.50)	(22.51)	(15.60)	(15.60)	(7.00)	(5.49)	(6.00)	(5.97)	(11.30)	(14.20)	(100.00)	(100.00)
1994 -95	82255.40	99367.86	50305.50	68023.00	34845.60	44956.58	23358.10	22259.23	19299.60	20390.00	36977.50	43387.30	247041.70	298384.87
	(33.30)	(33.30)	(20.30)	(22.80)	(14.10)	(15.07)	(9.50)	(7.46)	(8.00)	(6.83)	(15.00)	(14.54)	(100.00)	(100.00)
1995 -96	64759.20	82511.00	68484.00	53145.37	38462.60	36343.88	49032.00	24445.64	14761.20	19916.34	31322.50	33664.63	263221.50	250026.86
	(24.60)	(33.00)	(26.00)	(21.25)	(13.20)	(14.54)	(18.60)	(9.78)	(5.60)	(7.97)	(11.87)	(13.46)	(100.00)	(100.00)
1996 -97	88563.20	84739.02	76754.90	49030.17	53794.40	33678.25	43816.90	32871.73	29923.10	23819.21	58001.40	39083.13	350853.90	263221.50
	(25.24)	(32.19)	(21.90)	(18.63)	(15.30)	(12.79)	(12.50)	(12.49)	(8.53)	(9.05)	(16.53)	(14.85)	(100.00)	(100.00)
1997 -98	114221.00	115066.75	97228.00	74931.00	54573.00	41642.34	108600.30	41358.85	55668.00	32627.32	67515.00	45037.20	497805.30	350663.46
	(22.94)	(32.80)	(19.53)	(21.40)	(10.96)	(11.90)	(21.80)	(11.80)	(11.18)	(9.05)	(16.53)	(14.85)	(100.00)	(100.00)
1998 -99	251206.00	147380.05	126943.00	83498.72	82110.00	54020.00	108800.00	89260.84	84634.00	55650.00	103412.00	67995.57	757105.00	497805.18
	(33.18)	(29.61)	(16.76)	(16.77)	(10.84)	(10.85)	(14.37)	(17.93)	(11.19)	(11.18)	(13.66)	(13.66)	(100.00)	(100.00)

A : Actural E : Estimated

Figures in parentheses indicate percentage to the total

Table 3 : Projected turmeric exports to different countries (1999 - 2000 to 2009 -2010) (Rs. 000')

Year	UAE	USA	UK	Iran	Bangladesh	Japan	Total
1999 -2000	234787.64 (31.00)	140186.87 (18.52)	95958.00 (12.67)	110097.00 (14.54)	71871.00 (9.50)	104204.27 (13.77)	757104.78 -
2000 - 2001	236871.68 (31.30)	149035.07 (19.68)	95012.17 (12.55)	101546.22 (13.41)	70722.66 (9.34)	103917.20 (13.72)	757105.00 (100.00)
2001 - 2002	241299.42 (31.87)	148446.63 (19.61)	97558.08 (12.91)	96834.79 (12.79)	68296.67 (9.00)	104669.41 (13.82)	757105.00 (100.00)
2002 - 2003	242576.57 (32.04)	151533.27 (20.00)	98472.27 (13.00)	92954.54 (12.30)	67011.68 (8.85)	104556.67 (13.81)	757105.00 (100.00)
2003 - 2004	244216.93 (27.56)	152472.14 (17.20)	99903.38 (11.27)	218851.95 (24.70)	65899.40 (7.47)	104759.80 (11.80)	886103.61 (100.00)
2004 - 2005	257265.88 (29.03)	155762.44 (17.58)	101918.05 (11.50)	146731.02 (16.56)	94186.64 (10.63)	130239.58 (14.70)	886103.61 (100.00)
2005 - 2006	193985.32 (24.07)	164308.17 (20.38)	104999.70 (13.03)	134189.74 (16.56)	88956.50 (11.04)	119516.00 (14.83)	805955.43 (100.00)
2006 - 2007	188532.30 (25.27)	152593.90 (20.45)	90832.90 (12.18)	124740.14 (16.72)	83983.24 (11.26)	105350.30 (14.12)	746032.78 (100.00)
2007 - 2008	229767.64 (30.15)	136432.57 (17.90)	102425.70 (13.44)	116880.60 (15.33)	76803.50 (10.07)	99664.55 (13.11)	761974.56 (100.00)
2008 - 2009	230683.00 (30.27)	152715.00 (20.04)	92973.50 (12.20)	108164.00 (14.20)	74152.17 (9.73)	103332.88 (13.56)	762020.55 (100.00)
2009 - 2010	241358.94 (31.64)	145520.84 (19.10)	96971.42 (12.73)	102300.77 (13.43)	70390.51 (9.23)	105478.10 (13.84)	762020.58 (100.00)

Figures in parentheses indicate percentage to the total facilities are to be created till the farmers get remunerative and profitable prices. The farmers should be sensitized on various implications of WTO through wide publicity. World Trade Organization must make different countries aware of the market prices, production and demand levels of turmeric world wide from time to time through market intelligence and the same has to be informed to growers.

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Marketing of Mesta in Srikakulam District of Andhra Pradesh*

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ABSTRACT

The marketing of mesta confined to the producer / farmer and the final consumer is Jute mills to whom the fibre is sold. Of the two existing marketing channels the prominent one was "Producer → Village merchant → Kutcha baler → Consumer / Jute mills " as the farmers preferred to sell his produce at village level avoiding high transportation costs. Marketing efficiency is relatively same in both the channels.

Key Words : Mesta, Marketing, Consumer, Farmer, Producer, Kutcha baler.

Marketing has been accepted as an ideal 'nexus' between producer and consumer. An efficient marketing system not only helps in profitable disposal of the produce but also at a minimum cost ensuring grower a fair return for his skill. Production process of any commodity ends only when it reaches the hands of the ultimate consumer. The efficiency of marketing is therefore judged on the basis of share obtained by producer in consumer's rupee and corresponding satisfaction, which the consumer gets out of each rupee spent by him.

MATERIAL AND METHODS

Srikakulam District has been purposively selected for the study because it is the second predominent district growing mesta (20,050 hectares) next to Vizianagaram (46,002 hectares). Three predominent mesta growing mandals purposively selected for the study are Rajam, Etcherla and Regidi Amadalavalasa. The sample for the study consisted of 90 farmers, 15 village merchants and 15 kutcha balers, respectively. Marketing of mesta continues to suffer from several handicaps. The present study focussed light on various marketing aspects of mesta.

RESULTS AND DISCUSSION

Market structure for any commodity refers to all the business activities involved in moving the produce from its producer to the ultimate consumer. Market functionaries are involved to enable the sale of produce i.e,. mesta fibre from the producer to the ultimate consumer i.e., to the jute mills thus forming a market channel. The marketing channels for mesta are complex in the sense that they involve several stages based on the end product utilized. The study of marketing channels of mesta is limited till it reaches the consumer or jute mills in the form of fibre (Naidu, 1997). The various channels for marketing of mesta are :

Channel -I : Producer → Village merchant → Kutcha baler → Consumer / Jute mills.

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* The article is a part of the first author's M.Sc.(Ag.) dissertation work entitled "Economics of mesta in Srikakulam district of Andhra Pradesh.

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Table 2 : Marketing costs in different channels (Rupees / quintal)

Particulars	Channel - I		Channel -II	
	Rs q^{-1}	%	Rs q^{-1}	%
Net price received by producer	1205.35	92.72	1215.85	9352
Transportation	-	-	16.50	1.27
Market fee	-	-	3.00	0.23
Cost incurred by producer	-	-	3.00	0.23
Farmer's selling price or village merchant's purchasing price	1205.35	92.72	-	-
Cost incurred by village merchant				
Transportation	15.00	1.15	-	-
Market fee	3.00	0.23	-	-
Weighment	3.00	0.23	-	-
*God's fee	0.50	0.04	-	-
Storage	1.00	0.08	-	-
Village Merchant's total cost	22.50	1.73	-	-
Village Merchant's margin	15.00	1.15	-	-
Farmer's selling price / Village Merchant's selling price / kutcha baler's purchasing price	1242.85	95.60	1238.35	95.25
Transportation	17.50	1.35	17.50	1.35
Asorting and baling	2.40	0.18	2.40	0.18
Storage charges	1.25	0.09	1.50	0.11
Weighment	2.00	0.15	2.25	0.17
Loading and Unloading	2.50	0.20	2.50	0.20
Market charges	13.00	1.00	13.00	0.10
Kutcha Baler's total cost	38.65	2.97	39.15	3.02
Kutcha Baler's selling price or Consumer / Jute mills purchasing price	1300.00	100.00	1300.00	100.00

* God's fee is collected generally in this study area to perform the development activities of the respective village.

Channel -II : Producer → Kutcha baler → Consumer / Jute mills.

Channel -III : Producer → Consumer / Jute mills.

The channel-III *viz.*, producer to the consumer occurs rarely (4-5%) when the demand for the fibre is high, wherein the miller's agent buy the produce from the producer directly. This channel did not prevail during the period of study. Hence, the pricespread in Channel - I and Channel-II is presented in Table - 1. In Channel -I the mesta growers sell these bundles to the kutcha balers who bale the fibre and sell it to consumer or jute mills.

Rehman (1982) observed that only 7.95 per cent of the jute fibre was sold to Jute Corporation of India (JCI) and the remaining 92.05 per cent to private jute dealers suggesting a meagre role of JCI. The producer's net receipt was 92.72 per cent of the terminal market / consumer's price. Kutcha baler enjoyed the highest margin of Rs. 18.50 per quintal (1.43%) and the village merchant Rs. 15.00 per quintal

(1.15%) of the consumer's price. It is also observed that the different costs incurred at different stages accounted for about 4.66 per cent of jute millers purchasing price. In channel -II the producers transport their produce themselves to the market and sell the fibre to kutcha balers, who inturn sells to the consumer/ jute mills. The producer's net receipt was 93.52 per cent of the terminal market or consumer's price. Sharma and Tewari (1989) confirmed that larger the number of intermediaries involved lower the share in consumer's rupee. The Kutcha baler enjoyed the margin of Rs. 22.50 per quintal. The marketing cost accounted to Rs. 61.65 constituting 4.74 per cent of the jute mills purchasing price.

Table 2 : Marketing costs in different channels (Rupees / quintal)

Particulars	Channel		
	I	II	Average
Transport	32.50	34.00	33.25
Market fee	16.00	16.00	16.00
Weighment	5.00	5.25	5.12
Loading and Unloading	2.50	2.50	2.50
Assorting and baling	2.40	2.40	2.40
Storage	2.25	1.50	1.87
Total	60.65	61.65	61.15

The structure of marketing costs in the identified channels is presented in Table -2. Among the various components of marketing costs, transportation cost was the highest followed by the market fees in both the channels. This is in confirmation to the study conducted by Sikder and Banerjee (1983) who reported that the major item of jute expenditure was transportation. The weighment charges followed next, then loading and unloading. The costs towards assorting and baling occupied fifth position and the lowest place amongst the various components was occupied by storage. The transport cost was the highest in Channel-II i.e., Rs. 34.00 and the rest of the costs were almost similar in both the channels. The total marketing cost in Channel - I and Channel - II was Rs. 60. 65 and Rs. 61.65 with an average of Rs. 61.15.

The movement of goods from producers to consumers at the lowest possible cost, consistent with provisions of the services desired by the consumer may be termed as efficient marketing. Marketing efficiency (ME) was computed using Shepherd's formula:

$$ME = \left(\frac{V}{I} - 1\right) \times 100$$

Where

ME = Index of marketing efficiency

V = Value of goods sold or price paid by the consumer (retail price)

I = Total marketing cost or input of marketing.

Table 3 : Indices of marketing efficiencies (Rupees / quintal)

Particulars	Channel		
	I	II	Average
Value of goods sold (V) Rs/Q	1300	1300	1300
Marketing cost Rs / Q	60.65	61.65	61.15
Marketing efficiency	20.43	21.08	20.75

As per Table - 3 the marketing efficiency was highest in Channel-II followed by Channel-I. The average for the two channels was found to be Rs. 20.75. The transportation cost incurred by the producer decreased the marketing efficiency in Channel - II.

Conclusions

An eco-friendly, hardy and sustainable crop like mesta is losing its identity due to unremunerative price on one hand and stiff competition from synthetic goods. Products derived from natural origin should be encouraged. Effective steps have to be taken for the functioning of Jute Corporation of India (JCI) to collect the farmers produce *viz.*, fibre by opening market outlets at village level avoiding middlemen. Also necessary facilities like construction of retting tanks with adequate fresh water; storage facilities; providing training to farmers and offering remunerative price by the government would make possible high quality grade of mesta fibre available from farmer's end.

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Cost and Returns of Paddy in Yanam Region of Union Territory of Pondicherry

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ABSTRACT

The study highlighted that the cost of production of paddy per hectare was found highest among all the size groups. The total costs were high on large farms in both crop I (*Kharif*) and crop II (*Rabi*) with Rs. 18,094.26 and Rs. 19,071.29, respectively. Rental value on own land in the cost of production of crop II was more than crop I in all size groups. Gross returns per hectare was the highest on large farms followed by medium and small farms in both crop I and crop II. Net returns also showed direct relation with the farm size.

Key Words : Paddy, Cost, Returns, Size Group.

In India, paddy is the most important crop in terms of area and production which plays a significant role in improving food security of the country. Paddy cultivation in the country increased by over three times during last four decades. Agriculture in its turn is dominated by food crops as, it covers nearly 69 per cent of the total cropped area. The production trend indicated that maximum increase in production was 8.5 per cent. Among all the food crops, paddy occupies an unique position. Paddy is the most important staple food crop of majority of the world's population, occupying the first place among the cultivated cereals and is being grown under different agro-climatic conditions. It occupied an area of 44.3m ha with an annual production of 82.2 million tonnes with the productivity of 2811 kg ha^{-1} (Swaminathan, 2000). The objective of the study is to assess the cost and returns of paddy in Yanam region of Union Territory of Pondicherry.

METHODOLOGY

The present study was conducted in Yanam region of Union Territory of Pondicherry during the year 2000 - 2001. Yanam region was purposefully selected for the study, as no study was undertaken in this region so far. Four villages of Yanam region *viz.*, Kanakalapet, Mettakur, Farampet and Darivalatippa were included for the study. Paddy is the main crop in this region. Area under paddy was considered as the basis for selection of farmers. The selection of farmers was based on probability proportion to paddy area. The sampling size farms is prefixed at 90 and divided into three size groups namely, small, medium and large with 30 farmers in each group. The data were collected with the help of pre-tested questionnaire designed for the purpose through interview. The data collected from all the four villages were tabulated and calculated with the help of cost concepts to know about the cost of cultivation.

RESULTS AND DISCUSSION

Paddy is being grown both in crop I and crop II seasons in Yanam region. The first crop was grown from June to November (*Kharif*). The

Table 1 : Cost structure of Crop-I (*Kharif* paddy)

S.No.	Particulars	Small		Medium		Large	
		Value Rs. / ha	%	Value Rs. / ha	%	Value Rs. / ha	%
A.	**Variable Cost**						
1.	Human Labour	2357.10	14.62	2520.30	14.79	2705.50	14.95
2.	Machine Labour	1992.70	12.36	2085.00	12.16	2153.86	11.90
3.	Bullock Labour	167.40	1.04	125.80	7.34	101.60	5.60
4.	Seed	407.76	2.52	421.60	2.46	427.50	2.36
5.	Manures and fertilizers	2436.60	15.11	2582.76	15.07	2712.42	14.99
6.	Plant protection chemicals	1403.16	8.70	1444.09	8.43	1525.89	8.43
7.	Interest on working capital	361.50	2.24	317.23	1.85	398.76	2.20
8.	Miscellaneous	62.70	0.39	108.49	8.35	107.05	5.90
	Sub total	9188.92	56.99	9605.27	56.04	10132.58	56.00
B.	**Fixed Cost**						
1.	Land revenue	170.30	1.06	182.30	1.06	186.33	6.53
2.	Depreciation	174.96	1.08	231.89	1.35	260.05	1.43
3.	Interest on Fixed capital	200.02	1.24	222.70	1.29	239.00	1.32
4.	Rental value of own land	6387.30	39.62	6895.93	40.23	7276.30	40.21
	Subtotal	6932.58	43.00	7532.82	43.95	7961.68	44.00
	Total Cost (A + B)	16121.50	(100)	17138.09	(100)	18094.26	(100)

second crop was grown from December to April (*Rabi*). The results of crop I and crop II are discussed below.

(a) Crop I (*Kharif*)

It was observed that cost of cultivation per hectare increased with increase in farm size. It was Rs. 16,121.50 on small, Rs. 17,138.09 on medium and Rs. 18,094.26 on large farms. The cost of cultivation and physical returns per hectare increased with increase in farm size. The break up of total cost of cultivation indicated that there was a positive relationship between variable costs and total cost of cultivation. Variable costs varied from Rs. 9,188.92 on small farms and Rs. 9,605.27 on medium farms and Rs. 10,132.58 on large farms. Manures and fertilizers accounted for Rs.2,436.6 (15.11%) on small, Rs. 2,582.76 (15.07%) on medium and Rs. 2,712.42 (14.99%) on large farms. The total fixed cost accounted for Rs. 6,932.58 on small Rs. 7,532.82 on medium and Rs. 7,961.68 on large farms, respectively. Irrespective of the size groups, the maximum expenditure was due to rental value of own land followed by manures and fertilizers (Table1).

(b) Crop II (*Rabi*)

The cost of cultivation of crop II is more than crop I. The cost of cultivation in crop II was

Table 2 : Cost structure of Crop-II (*Rabi* paddy)

S.No.	Particulars	Small		Medium		Large	
		Value Rs. / ha	%	Value Rs. / ha	%	Value Rs. / ha	%
A.	**Variable Cost**						
1.	Human Labour	2662.01	16.07	2848.52	16.04	2913.50	15.27
2.	Machine Labour	1670.89	10.09	1835.66	10.33	1946.40	10.20
3.	Bullock Labour	243.09	1.47	251.22	1.41	148.80	7.80
4.	Seed	480.86	2.90	509.46	2.86	523.09	2.74
5.	Manures and fertilizers	2069.37	12.49	2203.88	12.41	2403.10	12.60
6.	Plant protection chemicals	1551.20	9.36	1614.16	9.09	1723.16	9.03
7.	Interest on working capital	238.28	1.43	264.00	1.48	294.64	1.54
8.	Miscellaneous	75.12	0.45	97.00	5.46	108.60	9.47
	Sub total	8990.82	54.29	9623.90	54.20	10060.29	52.76
B.	**Fixed Cost**						
1.	Land revenue	160.00	9.66	182.00	1.02	197.00	1.03
2.	Depreciation	174.96	1.05	231.89	1.30	260.00	1.36
3.	Interest on Fixed capital	110.00	0.66	144.00	0.81	170.00	8.91
4.	Rental value of own land	7103.30	42.89	7571.30	42.64	8383.00	43.95
	Subtotal	7568.26	45.70	8129.19	45.79	9010.00	47.24
	Total Cost (A + B)	16559.08	(100)	17753.09	(100)	19071.29	(100)

Rs. 16,559.08 on small, Rs. 17,753.09 on medium and Rs. 19,071.29 on large farms. The variable cost varied from Rs. 8,990.82 on small, Rs. 9,623.9 on medium and Rs. 10,061.29 on large farms. Human labour cost contributed maximum share followed by manures and fertilizers. The fixed cost accounted for Rs. 7,568.26, Rs. 8,129.19 and Rs. 9,010.00 on small, medium and large farms, respectively. The cost of plant protection chemicals shows direct relation with the farm size. The rental value of own land accounted for Rs. 7,103.30 (42.89%), Rs. 7,571.3 (42.64%) and Rs. 8,383.0 (43.95%) on small, medium and large farms, respectively (Table 2). The above results showed that the total cost of production was high for the large farms, which is the common phenomenon observed on both crop I and crop II of paddy.

Unit cost of production

The productivity was the highest on large farms followed by medium and small farms. The average yield of paddy per hectare in crop I is 58.5 quintals in large 54.62 quintals in medium and 49.1 quintals in small farms. In case of crop II also large farms recorded a maximum yield of 61.8 quintals per hectare followed by 57.2, and 53.1 quintals per hectare on medium and small farms, respectively. The per quintal cost of production in crop I was the highest in small

Table 3 : Unit cost of production and productivity in paddy farm

S.No.	Particulars	Farm size		
		Small	Medium	Large
A.	**Crop I (*Kharif* Paddy)**			
1.	Gross costs / ha (Rs.)	16121.50	17138.09	18094.26
2.	Yield of Paddy / ha (quintals)	49.10	54.6	58.50
3	Cost of production of paddy / quintal (Rs.)	320.33	314.88	309.30
4.	Gross income (Rs.)	25622.00	28830.00	38000.00
5.	Net income (Rs.)	9893.78	11630.80	12700.00
B.	**Crop II (*Rabi* Paddy)**			
1.	Gross costs / ha (Rs.)	16559.08	17753.09	19071.29
2.	Yield of Paddy / ha (quintals)	53.10	57.20	61.80
3	Cost of production of paddy / quintal (Rs.)	311.84	310.00	304.23
4.	Gross income (Rs.)	29926.00	32412.12	35428.00
5.	Net income (Rs.)	13366.98	14658.62	16626.27

farms, which was Rs. 320.33 followed by Rs. 314.88 in medium and Rs. 309.30 in large farms. In crop II the cost of production per quintal in small farms was Rs. 311.84, while for medium Rs. 310.0, and in large it was Rs. 304.23 (Table 3). The results obtained were in conformity with the findings of Kapre (1974) who reported that the yield (per hectare) increased while cost of production (per quintal) decreased with an increase in size of holding.

Cost concepts

According to cost AI, maximum costs were incurred for production of crop I than crop II. Even in crop I, large farms showed a maximum cost which accounted for Rs. 18,094.2 where as in the corresponding group in crop II it was Rs. 19,071.29. The cost of production per hectare according to cost B for crop I was Rs. 16, 121.50 on small, Rs. 17,138.01 on medium and Rs. 18,094.26 on large farms. The respective figures for crop II were Rs. 16,539.08, Rs. 17,753.09 and Rs. 19,071.29 on small, medium and large farms. The cost B was the highest on large farms followed by medium and small farms in both crop I and crop II. The commercial cost of cultivation according to cost C in crop I was Rs. 18,404.44, Rs. 17,559.51, Rs. 17,497.0 on large, medium and small farms, respectively. Especially in case of crop II maximum cost C was observed on large farms with Rs. 19,502.57 followed by medium Rs. 18,518.4 and small farms Rs. 18,060.48.

Gross and net returns

In case of crop I higher gross returns were obtained by large farms followed by medium and small with Rs. 38,000.00 Rs. 28.830.00 and Rs. 25,622.00. In crop II, gross returns were Rs. 29,926.00, Rs. 32,412.12 and Rs. 35,428.00 on small, medium and large farms, respectively. In case of net returns the higher returns were obtained by large farms followed by medium and small farms in both crop I and crop II.

Table 4 : Cost of cultivation according to cost concepts (Rs. per hectare)

Particulars	Cost AI	Cost B	Cost C
Crop I			
Small farms	9534.18	16121.50	17497.00
Medium farms	10019.46	17138.01	17559.51
Large farms	10578.96	18094.26	18404.44
Crop II			
Small farms	9325.78	16539.08	18060.48
Medium farms	10037.79	17753.09	18518.41
Large farms	10518.29	19071.29	19502.57

Conclusion

It can be concluded from the above results of the study that the cost of cultivation per hectare increased with increase in farm size due to the fact that factor inputs were used intensively on large farms. The total cost increased due to increase in hired human labour. Due to the prevalence of favourable climatic conditions, the acreage under paddy cultivation is more in crop II. Hence, the farmers are getting more profits from crop II.

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Factors Influencing the Performance of Tank Modernization Works in Visakhapatnam District of Andhra Pradesh

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ABSTRACT

The study revealed the extent of influence of different factors like maintenance expenditure, storage capacity, water user's organisation, tank location, well density on tank performance. The variation in tank performance explained by five variables considered for regression analysis was 53 per cent, 54 per cent and 71 per cent for major, minor and pooled tanks, respectively. In case of pooled tanks, tank performance can also be improved by encouraging the formation of water users organisation, increasing the expenditure on tank repair works and by increasing water storage capacity. The variable well density is having negative influence on tank performance.

Key Words : Tank, Irrigation, Ayacut, Modernization.

Tank irrigation is one of the oldest sources of irrigation in India and particularly important in South India, where it accounts for about one third of the irrigated area. In recent years the performance of these tanks is poor due to inadequate operation and maintenance, large scale development of ground water sources, disintegration of traditional irrigation institutions, heavy siltation, encroachment etc. Due to negligence in the management off tanks most by farmers receive inadequate quantities of water from tanks, though the tank irrigation forms a major part of the irrigation sources. In almost all tank irrigated areas, many socio - economic problems exist like unequal distribution of water resulting in frequent conflicts between head, middle and tail end farmers and technical problems like siltation of tanks, deterioration of tank bunds, repairs in sluices and the like etc.

Hence, this study was under taken particularly to identify the factors affecting the performance of tanks in Visakhapatnam district of Andhra Pradesh.

METHODOLOGY

The study was confined to Visakhapatnam district of Andhra Pradesh. A three stage random sampling was adopted to select mandals, tanks and farmers. In the first stage two mandals with maximum number of tanks were purposively selected and in case of second stage a total of sixty tanks with maximum ayacut area from the mandals were selected and post stratified into minor (< 80 ha) and major tanks (> 80 ha) according to ayacut area. From these, 10 minor tanks and 10 major tanks were randomly selected and in 3rd stage from each of these 20 tanks, six beneficiary farmers were randomly selected thus making the total sample size into 120 farms.

The information required for the study was collected from the selected respondents in person and information was recorded in a pretested questionnaire. Average and percentage analysis were used to study the water management practices at farm level. Data

Table 1 : Factors influencig the performance of minor tanks

Sl.No	Particulars	Variables	Regression coefficient bi	Standard Error Sebi	t ratio	Significance level
	Dependent variable tank performance	Y				
1	Maintenance expenditure Rs / ha	X_1	0.00987	2.3962	0.067	NS
2	Water stored in mcum / ha	X_2	0.5235	3.9839	3.521	**
3	Tank location	X_3	0.2870	0.062	1.948	**
4	Well density	X_4	0.02508	0.054	0.171	NS
5	Water users organisation	X_5	0.29076	0.0611	2.001	*
	Constant	a	1.648			
		R^2 =	0.54			
		n =	30			
		** -	Significant at 1% level			
		* -	Significant at 5% level			
		NS -	Non significant			
		n -	number of samples			

collected for all the 60 tanks were used for functional analysis to measure the relationship between the performance of tanks and the variables influencing the performance. The function fitted was :

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + \mu$$

where Y = Tanks performance measured as a ratio between actual area irrigated and settled command area in ha.

X_1 = Maintenance expenditure in lakh rupees / ha

X_2 = Water users organisation (dummy variable)

2, if organisation is present

1, if organisation is absent

X_3 = Well density / ha

X_4 = Water stored per ha mcum

X_5 = Tank location (dummy variable)

2, for tanks in favourable location (very close to source of irrigation)

1, for tanks in unfavourable location (distant from source of irrigation)

a = Constant

b_1, b_2, b_3, b_4, b_5 = Partial regression coefficients

μ = error term

RESULTS AND DISCUSSION

Factors influencing the performance of minor tanks

The result of the functional analysis with tank performance as the dependent variable for minor tanks is as follows. Total variation in tank performance could be explained by the specified explanatory variables. The unexplained variation might be due to farm size variation and encroachment of tank and some other factors, which could not be properly identified and accounted for. From the Table1 it was observed that the estimated coefficient of variable maintenance expenditure (X_1) was not found significant even though the coefficient showed positive sign. It did not significantly contribute to increase in the value of tank performance. The estimated coefficient of variable storage capacity

Table 2 : Factors influencig the performance of major tanks

Sl.No	Particulars	Variables	Regression coefficient bi	Standard Error Sebi	t ratio	Significance level
	Dependent variable tank performance	Y				
1	Maintenance expenditure Rs / ha	X_1	0.4695	6.0032	2.536	**
2	Water stored in mcum / ha	X_2	0.5829	7.1664	3.273	**
3	Tank location	X_3	0.1052	0.0682	0.611	NS
4	Well density	X_4	-0.3707	0.0488	2.034	*
5	Water users organisation	X_5	-0.2883	0.0859	1.355	NS
	Constant	a	0.2637			

R^2 = 0.53
n = 30
** - Significant at 1% level
* - Significant at 5% level
NS - Non significant
n - number of samples

(X_2) was found significant at 1 per cent level. This would indicate that every one additional unit increase in the water stored per hectare would increase the tank performance by 0.5235 unit. The coefficient of tank location (X_3) was found significant at 1 per cent level. This would indicate that a favourable condition of tank location would improve the tank performance by 0.287 unit. The coefficient of well density (X_4) was found to be non significant though the coefficient showed positive sign. That means it did not significantly contribute to increase the performance of tanks. The coefficient of water users organisation (X_5) was found significant at 5 per cent level. It could be inferred that the presence of water users organisation would improve the performance of tanks by 0.291 unit. Form the above results it could be inferred that 54 per cent of variation ($R^2 = 0.54$) in tank performance was explained by five variables considered for regression analysis. Three out of the five variables were significant in explaining the performance of tanks. They were water stored in the tanks (X_2), tank location (X_3) and water user's organisation (X_5). Of them water users organisation was significant at 5 per cent level and the other two variables were significant at 1 per cent level.

Factors influencing the performance of major tanks

The result of the functional analysis with tank performance as the dependent variable for selected major tanks is presented in Table 2 and discussed below. The estimated coefficient of maintenance expenditure (X_1) was found significant at 1 per cent level. This would imply that for every one unit increase in maintenance expenditure would increase the performance of tanks by 0.4695 unit. The coefficient of storage capacity (X_2) was found significant at 1 per cent level. This would indicate that an increase in the water stored per hectare by one unit would improve the tank performance by 0.5829 unit. The coefficient of tank location (X_3) was found non-significant. That means it did not significantly contribute to increase the performance of tanks. The coefficient of well density (X_4) was found negative and significant at 5 per cent level. It can be inferred that every 1 unit in well density would decrease tank

Table 3 : Factors influencig the performance of tanks (pooled)

Sl.No	Particulars	Variables	Regression coefficient bi	Standard Error Sebi	t ratio	Significance level
	Dependent variable tank performance	Y				
1	Maintenance expenditure Rs / ha	X_1	0.7354	5.4131	3.347	**
2	Water stored in mcum / ha	X_2	0.8135	6.0218	4.6762	**
3	Tank location	X_3	0.6452	3614	0.706	NS
4	Well density	X_4	-0.5853	0.2306	5.1216	**
5	Water users organisation	X_5	0.3132	0.0894	2.2861	*
	Constant	a	0.2637			

R^2 = 0.71

n = 60

** - Significant at 1% level

* - Significant at 5% level

NS - Non significant

n - number of samples

performance by 0.3707 unit. The coefficient of water users organisation (X_5) was found non-significant. The production elasticity was negative. It did not significantly contribute to increase in the gross returns. From the above discussion it could be inferred that 53 per cent of variation (R^2=0.53) in tank performance was explained by five variables considered for regression analysis. Three out of the five variables were significant in explaining the performance of tanks. They were maintenance expenditure (X_1), water stored per ha. in tanks (X_2) and well density (X_4). Of them maintenance expenditure and water stored in tanks were found to be significant at 1 per cent level, and well density is negative and significant at 5 per cent level.

Factors influencing the performance of tanks (pooled)

The result of the functional analysis with tank performance as the dependent variable for selected major and minor tanks (pooled data) is as follows. From the Table 3 it could be observed that the estimated coefficient of maintenance expenditure (X_1) was found significant at 1 per cent level. This would indicate that for everyone unit increase in the maintenance expenditure the tank performance would increase by 0.7354 unit. The coefficient of storage capacity (X_2) was found significant at 1 per cent level. This would indicate that an increase in water storage by one mcum would improve the tank performance by 0.8135 unit. The coefficient of tank location (X_3) was found to be non-significant even though the coefficient showed positive sign. It did not significantly contribute to increase in the value of tank performance. The coefficient of well density (X_4) was found negative and significant at 1 per cent level. It can be inferred that every 1 unit increase in well density would decrease tank performance by 0.5853 unit. The estimated coefficient of water users organisation (X_5) was found significant at 5 per cent level. It can be inferred that the presence of water users organisation would improve the performance of tanks by 0.3132 unit. From the Table 3 it could be inferred that 71 per cent of variation (R^2 =0.71) in tank performance was explained by five variables considered for regression analysis.

Four out of the five variables were significant in explaining the performance of tanks. They were maintenance expenditure (X_1), water stored (X_2) in the tanks, well density (X_4), water users organisation (X_5). Of them, water users organisation was found significant at 5 per cent level and the other three variables were significant at 1 per cent level.

Conclusion

It could be concluded that tank performance would continue to decline in future. These factors include heavy siltation, encroachment of tank foreshore area, poor maintenance of water control structures like sluices, channels etc., tank location in unfavourable condition, increasing well density and the absence of water users organisation.

The tank performance can be improved significantly by periodical investment on repair works for tanks such as repairing the sluices, structures and surplus weirs, desilting tanks to increase the storage capacity of tanks and cleaning the channels. The study shows that tank performance can be improved by encouraging the formation of water user's association. Water users association helps in managing the tanks by attending to small repair works like cleaning channels and desilting the tanks. Therefore, the water user's organisation should be encouraged to function efficiently resulting in improved performance of tanks. Adequate financial help and technical assistance are to be provided by the government to these associations.

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Economics of Buffalo Milk Production in West Godavari District of Andhra Pradesh - A Case Study

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ABSTRACT

\An investigation was undertaken in small, (1-2 she buffaloes), medium (3-4 she buffaloes) and large herd size (5 and above she buffalloes) milk producers in West Godawari District of Andhra Pradesh to examine the economics of buffalo milk production. Expenditure on fodder and concentrates formed the major share in the total cost of milk production in all the catagories of milk producers. The average cost of buffalo milk production was Rs. 7.95 per liter for small herd size milk producer, Rs. 7.92 per litre for medium herd size milk producer and Rs. 7.86 for large herd size milk producer. However, net returns per litre of buffalo milk were found to be highest in small herd size milk producers followed by medium and large herd size milk producers.

Key Words : Buffalo Milk, Milk Producer, Expenditure, Net Cost, Gross incom.

Dairying constitutes an important segment of farm sector in India. The information on costs and returns from dairying is crucial for policy planning to ensure that the producers get a remunerative price for their milk and consumers get milk and milk products at reasonable cost. Due to wide variations in resource endowment, the cost and returns from milk production vary a great deal across states in India. Therefore, it becomes imperative to conduct studies on economics of milk production in different parts of the country. Several studies have been carried out in various states on economics of milk production from both buffalo and cow (Patel *et al.*, 1988, and Grover *et al.*, 1992 in Bethinda district of Punjab, Deoghare and Bhattacharyya, 1994 in Uttar Pradesh, Gupta and Agarwal, 1996 in Himachal Pradesh and Baruah *et al.*, 1996 in Assam). But no such study has been conducted in West Godavari District of Andhra Pradesh which has large buffalo population and milk collecting centres run by Smithkline Beecham Consumers Health Care Ltd., for the manufacture of Horlicks.

The present study was carried out with the following objectives :

1. To ascertain the cost of buffalo milk production among different categories of milk producers.

2. To study the net returns from milk production accruing to different categories of milk producers.

MATERIAL AND METHODS

Multistage stratified random sampling technique was employed for selecting the sample households for the study. West Godavari district comprises of three revenue divisions and 47 mandals. From each revenue division two mandals and from each mandal two villages were selected purposively. From each village 12 milk producers were selected at random and categorized into three herd size owners *Viz.,*,

Table 1: Per day maintenance cost (in Rs.) and milk yield of buffaloes under different herd size groups

	Green fodder	Dry fodder	Concen. trates	Labour	Vety. & Misc. Expenses	Depreci- ation @	Interest on fixed capital	Gross cost	Income from dung	Net cost	Milk yield in litres*
Small herd size	6.50	5.00	4.20	9.60	0.30	3.15	2.96	31.71	3.70	28.01	3.52
Medium herd size	9.50	8.75	7.50	9.75	0.50	3.45	3.15	42.60	4.00	38.60	4.87
Large herd size	10.25	9.75	12.50	10.50	1.00	4.75	4.50	53.25	5.25	48.00	6.10
Overall	8.75	7.83	8.06	9.95	0.60	23.78	3.53	42.52	4.31	38.20	4.83

* Per animal milk yield

@ Includes depreciation on animal, cattle shed and dairy equipment

small herd size milk producers (having 1 - 2 adult she buffaloes), medium herd size milk producers (3-4 adult she buffaloes) and large herd size milk producers (having 5 and above adult she buffaloes) and it was ensured that for each herd size four milk producers are taken. Thus in all 144 milk producers from 12 villages were selected as respondents for the present study. The data for the study were collected by the survey method of enquiry for the period 2000 - 2001 relating to the quantity and price of green fodder, dry fodder and concentrates fed to the milch buffaloes, labour used in milk production, wage rates of labour, veterinary and medical expenses, miscellaneous expenditure such as electricity expenses in chaff-cutting, purchase of ropes, chains and tools, machine repairs, etc., present market value of milch animals, dairy equipment and cattle shed, interest on fixed capital, milk yield and its sale price in respect of buffaloes maintained by different herd size groups. To compute the maintenance cost of each buffalo all the costs incurred in rearing the animal were aggregated. The fodder costs were worked out at the prevailing market prices. In the case of grasses the cost was estimated as per the cost of labour in fetching them. Where ever the family labour was used in milk production in the study area its cost was imputed on the basis of the average wage paid to permanent hired labour.

Depreciation on animal, dairy equipment and cattle shed was calculated by the straight line method. The net cost of maintenance was arrived at by deducting the income from dung from the gross cost of maintenance. The cost per litre of buffalo milk production were obtained by deducting the cost of milk production from the sale price of milk.

RESULTS AND DISCUSSION

Maintenance Cost

It may be observed from Table 1 that the average maintenance cost of buffalo in the study area was Rs. 38.20 per day. It varied from Rs. 28.01 in the case of small herd size milk producer. The maintenance cost increased with increase in the size of the milk producer. The maintenance cost increased with increase in the size of the herd as the higher category milk producers mostly having high producing improved buffaloes like graded Murrah and Murrah, which incurred higher feed cost which they could afford due to their resource endowment.

The average maintenance cost was around Rs. 38.20 per day. But there was

Table 2 : Cost and returns per litre of buffalo milk production (in Rs.)

	Cost of milk production	Sale price	Net returns	Cost excluding family labour	Family labour income
Small herd size milk producer	7.95	10.00	2.05	5.23	2.72
Medium herd size milk	7.92	10.00	2.08	6.92	1.00
Large herd size milk	7.86	10.00	2.14	7.86	--
producer Overall	7.91	10.00	2.04	6.67	1.24

significant variation in maintenance cost as between the different herd size groups. The small herd size milk producer had the lowest cost (Rs. 28.01) as their expenditure on feed cost and labour cost was the minimum whereas the large herd size milk producers incurred the highest cost of maintenance (Rs. 48.00).

Milk Yield

The average milk yield per milch buffalo per day was found to be 4.83 litres. The highest milk yield was obtained by the large herd size milk producers as they incurred higher cost of feeding than that of small and medium herd size milk producers.

Economics of Milk Production

As per the Table 2 the average cost of milk production was Rs. 7.95 per litre for small herd size milk producer, Rs. 7.92 per litre for medium herd size milk producer and Rs. 7.86 per litre for large herd size milk producer. The highest net returns per litre accrued to the large herd size milk producer (Rs. 2.14) and the lowest to the small herd size milk producer (Rs. 2.05).

However, if the cost of family labour is not taken into account in calculating the cost of milk production, there is significant increase in net returns which may be termed as family labour income. It mainly accrued to small herd size milk producer.

Conclusion

From the present study it may be concluded that buffalo enterprise in small herd size milk producers should be encouraged as the net returns offered is more for them when we have taken imputed value of family labour into consideration.

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Suggestions Given by The Members of Water Users' Associations in Andhra Pradesh for Better Performance

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ABSTRACT

The study was conducted in Khammam district of Andhra Pradesh which is irrigated by the Nagarjuna Sagar Left Canal project (NSLC). Under this project, a total 237 WUAs were formed in the district, out of which six WUAs on the 19th Major distributar canal were purposively selected for the study. One specific objective of the study was to know the suggestations given by the members of the WUAs i.e., the users and the Presidents, to improve the performance of their associations. The results revealed that majority (71.11%) of the head reach farmers suggested that all the canals must be repaired immediately while majority of tail enders (83.33%) suggested that severe punishment must be given to unauthorized irrigation. Major suggestions given by all the Presidents were that the discharge must be fixed according to the soils, and works must be approved quickly so that they can be started early. Government should provide more funds to take up works and the Warabandhi schedule should be implemented strictly throughout NSLC.

Key Words : Water Users Association, Performance, Historic Legislation, Irrigation systems.

Water is scarce resource which requires to be harnessed and utilised in the most efficient manner. The widespread deterioration of irrigation infrastructure with little or no participation from farmers has aggravated the improper utilization of canal irrigation water in our country. The lack of cooperation between the Government and farmers, and among farmers, creates a situation where water available does not always correspond to the demand pattern of farmers. Moreover, the Government finds it difficult to manage and supervise due to high administrative cost and too laborious for a bureaucracy. It is therefore desirable and essential that management of irrigation systems is restructured to make water management, more efficient with farmers participation.

The state of Andhra Pradesh has recently initiated a major irrigation sector reform program by enacting a historic legislation in April 1997, namely "The Andhra Pradesh Farmers Management of Irrigation Systems Act, 1997", under which a structure for farmers organizations has been created for all irrigation systems in the state. Under this Act, 10,292 WUAs were formed throughout the state and are functioning since three years under the rules and regulations laid down by the Act. But it was felt necessary that a scientific approach to know the suggestions given by the members of WUAs was essential so as to further improve their performance. Hence, the present study was undertaken with one specific objective to know the suggestions given by the members of the WUA i.e. the users and presidents for better performance.

MATERIAL AND METHODS

The study was conducted during 2000 - 2001 in Khammam district of Andhra Pradesh

Table 1 : Suggestions given by the users for better performance n=180

Sl.No.	Suggestions	Respondents			
		Head reach (n=90)		Tail end (n=90)	
		Frequency	Per cent	Frequency	Per cent
1.	All repairs to canals and other structures must be undertaken immediately	64	71.11	75	83.33
2.	All works must be started before onset of monsoon	57	63.33	62	68.88
3.	Discharge must be fixed according to soils of this region	40	44.44	46	51.11
4.	Warabandhi schedule must be strictly implemented throughout NSLC	37	41.11	52	57.77
5.	Severe punishment must be given to unauthorised irrigation	25	27.77	75	83.33
6.	All the water users must vote in election	22	24.44	-	-
7.	OP must be revised taking the entire ayacut into account	21	23.33	16	27.77
8.	Adequate loans and funds must be provided to take up works	20	22.22	41	45.55
9.	Meetings must be held more frequently for general body	17	18.88	8	8.88
10.	Separate power line must be established for running the lift	-	-	23	25.55

which is irrigated by the Nagarjuna Sagar Left Canal Project. All the six WUAs formed on the 19th major distributary canal were studied. As many as 24 villages from six WUAs were purposively selected i.e., 2 head reach villages and 2 tail end villages from each association and 15 head reach and 15 tail end farmers from each WUA were interviewed making a total of 90 head reach and 90 tail end respondents for the study. Moreover, all the six Presidents of the six selected WUAs formed another category of respondents. The data were collected by using pretested structured schedule through personal interview method.

RESULTS AND DISCUSSION

Table 1 is an indicator of the suggestions given by the water users for improving the performance of WUAs. The results revealed that majority of head reach farmers (71.11%) and tail enders (83.33%) had suggested all repairs to canals and other structures must be undertaken immediately. This may be because the canals were in a poor condition, broken at many places due to trampling by men and cattle. The lining also was very poor leading to leakage of water and thereby scarcity. This was in line with the findings of Paramanick and Mellick (1995).

A high per cent (83.33%) of tail enders have suggested that severe punishment must be given to those practicing unauthorized irrigation. Farmers at head reaches used motors and pumpsets to draw out water illegally thus bringing very poor discharge to tail enders. This was why majority of tail enders had given this suggestion. This finding was in line with that of Jayaraj (1998). Another major suggestion given by both the head reach (63.33%) and tail end (68.88%) farmers was that all works have to be undertaken before the onset of monsoon. The reason given was that works prioritized were not being commenced on time by the committee due to delayed administrative approval. By the time works started, monsoon would set in bringing water into the canal thereby hindering the progress of works.

Table 2 : Suggestions given by presidents for better performance n=180

Sl.No.	Suggestion	Frequency	Per cent
1.	Discharge must be fixed to this region according to the soils	6	100.00
2.	Government should sanction more funds to take up works	6	100.00
3.	Works must be approved quickly by higher authority so that they can be started early	6	100.00
4.	The Warabandhi schedule must be strictly implemented through out NSLC	6	100.00
5.	The OP must be revised taking the entire ayacut into consideration	5	83.33
6.	Training on irrigation related aspects should be given to all users and committee members	3	50.00
7.	All the presidents must take action against those practicing unauthorised irrigation	3	50.00
8.	Higher officials of departments must attend the meetings and discuss with farmers	2	33.33
9.	Lascars must also be given training on technical aspects	2	33.33
10.	More lift schemes must be taken up at tail end regions	2	33.33
11.	There must be a separate power line for existing lift scheme	1	16.66

The results in Table 2 revealed the suggestions given by all the Presidents of the selected WUAs. The major suggestions as expressed by all the Presidents were that the discharge must be fixed according to the soils of the region, works must be approved quickly, so that they can be started early, Government should provide more funds to take up works and the Warabandhi Schedule must be implemented strictly through out NSLC. The reasons given were that the discharge for entire NSLC was being fixed as per the deltas which was not sufficient here due to the poor water retention capacity of the soils of this region. The Warabandhi Schedule also was implemented only for Khammam District and not for the other two districts under NSLC, thereby reducing the discharge here. Moreover, Government is not providing sufficient fund to take up works and even for works prioritized, the approval is delayed due to administrative reasons. These are hindering quick accomplishment of works. Another major suggestion (83.33%) given by the Presidents was that the operational plan must be revised taking entire ayacut into consideration so that the discharge designed would be sufficient for the entire area being irrigated under NSLC. Some of the areas non-localised are now being irrigated from the canal due to which the discharge is not being sufficient for the entire ayacut.

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Profile of Agricultural Officers

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ABSTRACT

A study was conducted in Guntur district of Andhra Pradesh on profile of Agricultural officers, indicated that majority (70.59%) of the Agricultural officers were graduates, with farming as background (41.18%) with less than 10 years of service (48.63%). Rural orientation (69.76%), utilization of information sources (69.12%), perception of work load (89.71%), job satisfaction (63.23%), level of aspiration (94.12%), achievement motivation (61.76%), change proneness (69.12%) and concern for environment (63.23%) of the Agricultural officers were found under medium category.

Key Words : Profile, Rural Orientation, Perception of Work load, Agricultural Officers, Job satisfaction.

Seventy to eighty per cent of recent increases in production has been due to increased yields rather than greater area under agriculture (World Bank, 1993). In modern scenario there are lot of advanced farm technologies being generated in various State Agricultural Universities and Institutions like ICAR, ICRISAT etc. This new agricultural technology is the result of solid foundation and careful planning in agricultural research. This has been described by Plunkett (1993), scientific advisor to the CGIAR, as the greatest agricultural transformation in the history of human kind, and most of it has taken place during our life time. The change was brought about by the massive application of science and technology leading to higher and more stable food production, ensuring food stability and security for a constantly growing world population.

Agricultural development depends not only on the technology generation but largely on dissemination of technology into the rural society. The technology frame should be educative rather than prescriptive, it should promote pro-activity in clientele rather than seeking compliance. For this it must explain not only what to do, how to do, but also why aspect of every recommendation, so that farmers can exercise this wisdom and make their own judgement (Sinha, 1996). Satapathy (1996) expressed that the extension professionals have definite responsibility and accountability in sustaining production and productivity of agriculture. In order to think ways and measures to improve the extension services qualitatively, it is imperative to study the extension competencies of Agricultural Officers, who are the field level extension personnel with Agriculture degree as background.

Extension workers are like the nervous system in the process of rural development. Agricultural officer play a key role in department programmes by reviewing and assisting the job of field level agricultural extension officers and

Table 1 : Empirical measurement of the variables selected

S.No.	Name of the Variable	Empirical measurement
1.	Education	Structured schedule
2.	Parental occupation	Structured schedule
3.	Rural orientation	Schedule developed by Mishra (1991)
4.	Job experience	Structured schedule
5.	Inservice training received	Structured schedule
6.	Utilisation of information services	Schedule developed by Sumana (1995) with suitable modifications
7.	Perception of work load	Schedule developed by Katteppa (1984) and followed by Suresh (1995)
8.	Job satisfaction	Schedule developed by Rao (1985)
9.	Level of aspiration	Scale developed by Contrill (1965) followed by Reddy (1988)
10.	Achievement motivation	Scale developed by Manandhar (1987)
11.	Change qroneness	Scale developed by Moulik and Rao (1972) with suitable modificatoins
12.	Concern for environment	Structured schedule

by providing technical support to them. They also conduct farmers trainings in farmers fields, participating fortnightly training sessions and hold fortnightly review meetings with AEOs under their jurisdiction. The important position of this crucial change agent in the extension approach makes it necessary to know him in all dimensions. It is well known that a professional extension service will not survive in its reality without technically competent, skilled and highly motivated functionaries. Hence, a greater responsibility is on the shoulders of Agricultural Officers who are in the field extension, particularly. With this background the present study was carried out with the following objective

1. To know the personal and socio-psychological characteristics of Agricultural officers working in the field extension.

METHODOLOGY

The investigation was carried out in Guntur district of Andhra Pradesh. All the AOs working in the field extension (68) constituted the sample. Twelve independent variables covering the personal, socio and psychological dimensions, were selected. Selection of variables was based on review of literature and judges opinion. A list of 33 variables were sent to 40 judges (Country wide) with a proforma of highly relevant, relevant and least relevant with 3,2 and 1 weightage, respectively. Twenty six judges have given their responses. Based on weighted mean score, variables whose mean score was higher than average mean score were selected for the study. For empirical measurement, schedules were developed with suitable modifications and for some schedules were formulated for the purpose and were used (Table 1).

RESULTS AND DISCUSSION

Education

A perusal of the data in Table 2 indicated that 70.59 per cent were graduates in Agriculture and the rest (29.41%) were post - graduates. Results revealed that majority of AOs were

Table 2 : Distribution of the respondents according to their education (n =68)

S.No.	Category	Respondents	
		Frequency	Percentage
1.	Graduate in Agriculture	48	70.59
2.	Post Graduate in Agriculture	20	29.41
	Total	68	
	Mean : 1.2941	S.D = 0.4590	

Table 3 : Distribution of respondents according to their parental occupation (n =68)

S.No.	Category	Respondents	
		Frequency	Percentage
1.	Farming	28	41.18
2.	Govt. service	26	38.23
3.	Business	14	20.59
	Total	68	
	Mean : 2.2059	S.D = 0.7834	

Agricultural graduates which is at par with minimum educational qualification required for the post of AO. About 30 per cent of the AOs were having post - graduate qualification indicating that the staff were well equipped in the technical know how and can take care in solving the basic and routine problems of the farmers.

Parental occupation

It is evident from the Table 3 that higher (41.18%) proportion of the AOs came from farming families. It appears that agricultural background of parents encouraged their children to enter into related fields only. Also due to contact with extension agencies, parents might have developed the feeling of security in joining such professions.

Job Experience

Experience acquires a special significance as far as efficiency is concerned. It is viewed from the Table 6 that nearly half (48.53%) of the AOs had an experience of about 10 years. On an average AOs have 14 years of experience. This shows that AOs are well experienced in their job and they can be efficiently utilised for successful communication of advanced technologies.

Inservice Training received

It was observed from the Table 5 that 38.24 per cent of the AOs received more than 90 days of training during their service, whereas about one third (33.82%) of the AOs received less than 30 days training. The AOs were given training on different areas like *kharif* rice production technology, summer pulse production technology, IPM in cotton, soil and water conservation and pesticide formulation. In service training aims at developing better insight and improving the professional competency of personnel.

Table 4 : Distribution of respondents according to their job experience (n =68)

S.No.	Category	Respondents	
		Frequency	Percentage
1.	Less than 10 years of experience	33	48.62
2.	11 to 20 years of experience	9	13.24
3.	More than 20 years of experience	26	38.24
	Total	68	
	Mean : 13.8529	S.D = 9.2563	

Table 5 : Distribution of respondents according to their inservice training received (n =68)

S.No.	Category	Respondents	
		Frequency	Percentage
1.	Less than 30 years of training	23	33.82
2.	31 to 60 years cf training	19	27.94
3.	More than 90 days of training	26	38.24
	Total	68	
	Mean : 69.6029	S.D = 72.1452	

Rural orientation

Analysis of results in Table 6 revealed that majority (61.76%) of the AOs were having medium rural orientation followed by low (22.06%) and high (16.18%) rural orientation. Rural orientation provides first hand knowledge about rural life as the AOs should serve the farmers in rural areas. This rural background may help them to understand the problem of beneficiaries.

Utilisation of Information Sources

It is apparent from the Table 6 that majority (69.12%) of the Agricultural Officers had utilised the information sources to the medium extent. It was observed that most of the AOs were utilising the mass media like folders, T.V., leaflets, farm magazines (Annandatha, Swarnasedyam, Padipantalu) and formal sources like immediate superiors (ADA) and university scientists. The reason that could be ascribed for this is that they have utilised the accessible sources of information from them.

Perception of work load

As regard the perception of work load, great majority (89.41%) of the AOs perceived medium work load. The organisational stress was found to be optimum, as they do not feel any heavy and tedious work to be completed by them. This may be due to the fact that the work commitment and nature of work was at the disposal of AOs.

Job satisfaction

It is obvious from the Table 6 that majority (62.23%) of the AOs had medium job satisfaction followed by high (22.07%) and low (14.70%) job satisfaction. Job satisfaction is primarily a result

Table 6 : Distribution of respondents (n =68)

S.No.	Variable	Low	Medium	High
1.	Rural orientation	15(22.06)	42(61.76)	11(16.18)
2.	Utilisation of information sources	7(10.28)	47(69.12)	14(20.59)
3.	Perception of work load	2(2.94)	61(89.71)	5(7.35)
4.	Job satisfaction	10(14.70)	43(63.23)	15(22.00)
5.	Level of aspiration	2(2.94)	64(94.12)	2(2.94)
6.	Achievement motivation	11(16.18)	42(61.76)	15(22.06)
7.	Change proneness	10(14.70)	47(69.12)	11(16.18)
8.	Concern for environment	12(17.65)	43(62.23)	13(19.12)

Figures in parenthesis indicate percentage of respondents

of high productivity. It is a matter of common observation and experience that ultimate job satisfaction rests on variety of factors. Usually AOs attain job satisfaction not by mere salaries but due to their commitment and zeal in extending supply and services to the farmers. The job satisfaction of AOs progressively increases when his clientele practices the things he taught.

Level of Aspiration

Results indicated that vast majority (94.12%) of the respondents fell under medium level of aspiration. It can be stated that one should set realistic and moderate level of aspiration in one's professional life and the distribution pattern in all probability represented real life situation.

Achievement motivation

Majority (61.76%) of the AOs were found under medium category followed by high (22.06%) and low (16.18%) category. This might be due to the fact that AOs were performing conflicting role through advisory work, attending to cyclone - relief works, election duties and other rural development works. Because of their multiple roles on the job, they might have desired to excell to moderate level only.

Change proneness

Results furnished in the Table 6 indicated that majority (69.12%) of the AOs have medium change proneness. They may be prone to change to meet the challenging demands and needs of the farmers while performing their duties.

Concern for environment

An observation of the findings in the Table 6 revealed that more than 80 per cent of the AOs were found to be committed to the environment from medium to low extent. This implies that AOs were more concerned and involved with the programmes of the State Government like Janmabhoomi, Clean and Green etc., other than the regular duties. However, their participation in the environmental related programmes was observed to be as part of duty with a little bit of personal interest as well.

From the results, it is evident that majority of the respondents were graduates in agriculture with 10 years experience having their parental occupation as farming. Majority had received an inservice training for more than 90 days and utilised information sources to the medium extent. Further, the majority were observed in medium category with respect to rural orientation, perception of work load, job satisfaction, change proneness and concern for environment.

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Involvement of Researchers in Different Stages of Technology Generation in Acharya N.G. Ranga Agricultural University

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ABSTRACT

The process of generation of technologies includes number of stages. Involvement of researchers in all the stages and in all the activities results effective technology generation. National Agricultural Research Project was implemented in ANGRAU for a period of twelve years. During this period research stations were strengthened in all respects. Experiments were conducted systematically and a number of technologies were generated. This study was conducted to know the extent of researchers involvement in some selected stages of technology generation processes. The data were collected from 103 researchers from seven lead research stations spread over six agro-climatic zones with the help of schedules. Data were analysed with the help of suitable statistical procedures. As a whole the researchers participation in different stages of technology generation was high. This participation was high in the activities like, interpretation of data, collection of data in prescribed proforma, preparation of calender of operations, carrying out the experiments according to objectives, verification of research results in other stations, and low in conduct of on-farm trials. Majority of researchers documented the research results in report form and presented in Zonal Research Extension Agricultural Committee meetings.

Key Words : Technology Generation, Involvement of Researchers, Agro - Climatic Zones, Interpretation.

Formulation and implementation of research projects were needed for the generation of technologies. The process of generation of technologies include number of stages. Among them were conducting experiments, verification of research results at other stations, in farmer's fields as on-farm trials and presentation, and documentation of the research results in which researchers play an important role. Chantalakhana (1977) emphasised the need for personal involvement of the scientists in various research operations for effective generation of technology.

During period of the National Agricultural Research Project in Acharya N.G. Ranga Agricultural University (ANGRAU) formerly Andhra Pradesh Agricultural University (APAU) the research stations were strengthened in order to carry out research on need based, location specific and production oriented technologies. Researchers involvement was a must in all the stages of research from identification of problems to documentation and dissemination of these research results to the clientale. Hence this study was taken up to know the extent of researchers involvement in selected stages of technology generation process with the following objectives.

1. To study the extent of participation of researchers in various activities in selected stages of technology generation.
2. To find out from the researchers about the conduct of verification trials in other research stations and their involvement in on-farm trials, and
3. To ascertain from the researchers about the documentation and presentation of research results.

Table 1 : Responses of researchers towards the activities of conduct of experiment

S.No.	Activity	Frequency	Percentage	x^2 value
1.	Preparation of calender of operations and observation sheets	100	97.08	3.10 NS
2.	Conducting the experiment according to plan	100	97.08	3.10 NS
Layout of the experiment				
3.	Researcher himself	57	55.33	10.87 NS
4.	With the help of others	46	44.66	4.93 NS
5.	Getting all the operations started	61	59.22	4.95 NS
Observations made by				
6.	Researcher himself	36	34.95	2.70 NS
7.	Others	67	65.04	1.88 NS
8.	Collection of data in the prescribed sheet as per the plan	103	100.00	1.00 NS
Analysis of data				
9.	Self	37	32.03	32.52**
10.	Help of others	70	67.96	14.91*
Method of data analysis				
11.	Computer	47	45.63	34.26**
12.	Calculator	83	80.58	17.09*
Interpetation of data				
13.	Self	103	100.00	1.00 NS
Extent of data utilized				
14.	Full	82	79.61	7.57 NS
15.	Partial	20	19.42	4.20 NS
16.	Conformation of results	92	83.32	7.05 NS
17.	Results in line with objectives	101	98.05	4.94 NS
Continuation of Experiments till the achievement of objectives				
18.	Fully	77	74.75	11.63 NS
19.	Partially	26	25.24	6.48 NS

H value 10.99 NS

** Significant H, $x^2 = 16.81$ at 0.01 probability level

* Significant H, $x^2 = 12.59$ at 0.05 probability level

NS = Non significant

MATERIAL AND METHODS

The researchers, who had six years experience in research and involved in technology generation were selected from seven lead research stations of ANGRAU. Data were collected from 103 such researchers with the help of questionnaires. The questionnaires were prepared based on literature and experts suggestions. The questionnaires contain four major activities. First activity was to conduct of experiments which had nineteen activities, second activity contained two sub-activities pertaining to verification of results in other research stations, third major activity was on-farm trials which had 10 sub-activities and fourth major activity the documentation and presentation of research results had five sub activities. The

Table 2 : Researcher towards verification of research results at other stations

S.No.	Activity	Frequency	Percentage	x^2 value
1.	Verified	66	64.08	0.73 NS
2.	Non Verified	37	35.92	0.73 NS

H value 11.21 NS

NS = Non significant

responses of the researchers were obtained for each activity. A score of one was allotted to each sub-activity to which the researchers responded. The total score was arrived at by summing up the score on each sub-activity which formed the score of the respondent. Extent of participation of researchers were expressed in frequencies and percentages. The overall differences among the researchers for four major activities were determined by using Kruskal - Wallis one way analysis of variance and differences between researchers for each sub-activity was determined with the help of chi-square test for independent samples.

RESULTS AND DISCUSSION

Researcher's involvement in different activities while conducting the experiment

The Kruskal - Wallis one-way analysis of variance test indicated that there was no significant difference among the researchers with regard to their participation in different activities while conducting experiments. The x^2 test for independent samples revealed that in the activities like analysis of data by self, with help of others, use of computer and calculator for analysis of data showed significant difference, which indicated that in the above four activities different researchers behaved differently (Table 1).

Regarding the extent of participation of researchers in different activities, (Table 1) all the respondents collected the experimental data as per the prescribed plan and interpretated the data. This result is in conformity with the result of Sabarathnam (1987) who observed the same. Majority (98.05%) of the researchers said that their results were in line with the objectives of the experiments. Their participation in other activities like preparation of calender of operations and observation sheets, carrying out the experiment according to plan (97.08%), confirmation of results (83.32%) and utilization of data fully (79.61%) were more encouraged. Sabarathnam (1987) reported 95 per cent of the scientists laid out the experiments but in this study 55.53 per cent of the researchers laid the experiments by themselves and 44.66 per cent with the help of others. Majority (59.22%) expressed that the different activities were started in their presence. Majority (65.04%) of them expressed that the observations were made by others and 34.95 per cent of the researchers made observations by themselves.

Nearly 67.96 per cent of researchers depended on others for analysis of data but 32.03 per cent of them analysed the data by themselves.

Majority of the researchers (80.58%) analysed their data by using calculator than computer (46.63%), few researchers (25.24%) continued their experiments upto partial fulfillment of objectives.

Table 3 : Researchers responses towards on-farm trials

S.No.	Activity	Frequency	Percentage	x^2 value
1.	Tests in farmer's fields	83	80.58	8.18 NS
2.	Aware of locations	76	73.78	2.21 NS
3.	Self involvement	5	4.85	28.76**
4.	Others' nvolvement	59	57.28	13.60*
5.	Visit to trials	55	53.59	3.63 NS
6.	Results confirmed	45	43.68	3.48 NS
7.	Report on Trials	25	24.27	3.35 NS
8.	Feed back received	49	47.57	4.26 NS
9.	Farmer's reaction	50	48.54	16.94**
10.	Action taken based on Extension personnel and farmers feedback	35	33.98	15.83**

H value 2.56 NS

** Significant H, $x^2 = 16.81$ at 0.01 probability level

* Significant H, $x^2 = 12.59$ at 0.05 peobability level

NS = Non significant

From the above results, it can be concluded that majority of the researchers involved in many of the activities of the experiment without any significant difference in conduct of experiment. Their involvement in the activities like interpretation of data, collection of data in prescribed proforma, preparation of calender of operations and carrying out the experiment according to the plan until the achievement of objectives and the confirmation of results were laudable.

Verification of research results

There was no significant difference among the researchers in verification of results in other research stations as the H value and x^2 values were not significant (Table 2).

Many (64.08%) of the researchers verified the research results at other verification stations where as, 32.52 per cent of them were not utilized this facility (Table 2). Sabarathnam (1987) observed only 46 per cent of the scientists verified the research results in other research stations. It may be due to non-availability of suitable research stations to test their research results. It can be concluded that many of the researchers verified the research results in other stations without any difference.

On-farm trials

Conduct of on-farm trials is an important step in the process of technology generation, in which changes can be made in the technologies based on the feed back of extension personnel and farmers. However, the analysis indicated that the researchers who conducted research did not involve themselves in conducting on farm trials (Table 3).

There was no significant difference among the researchers in conduct of on farm trials as the H value was not-significant (Table 3). As per the x^2 values in some of the activities like self involvement of researchers, others involvement, in getting farmers reaction and action taken based on feed back of extension personnel and farmers there were significant differences among the researchers (Table 3).

Table 4 : Reseadrchers responses towards documentation, publication and pesentation of research results.

S.No.	Activity	Frequency	Percentage	x^2 value
1.	Report writting	76	73.78	20.22**
2.	Computerisation	11	10.67	16.88**
3.	Publication	29	28.15	4.14 NS
4.	Presented in seminars	21	20.38	5.04 NS
5.	Presented in ZREAC meeting	67	65.04	14.07*

H value 4.28 NS

** Significant H, $x^2 = 16.81$ at 0.01 probability level

* Significant H, $x^2 = 12.59$ at 0.05 peobability level

NS = Non significant

With regard to the involvement of researchers in on-farm trials (Table 3) only 4.85 per cent of them involved in conduct of on farm trials (29.00%) in case of Sabaratnam (1987). As per the responses of the researchers 57.28 per cent of the trials were conducted by others. Majority (50.58%) of the researchers indicated that their results were tested in farmers fields and 73.38 per cent visited the trials. Sabaratnam (1987) also indicated similar results, where 54 per cent visited the trials. Even though 48.54 per cent of the farmers reacted to the trials but researchers received feed back upto the extent of 47.57 per cent.

Less than fifty per cent (43.68%) of the researchers expressed that the results of on farm trials were in line with the research results, whereas only 33.98 per cent of them taken action on the feed back received from the extension personnel and farmers.

It could be inferred from the above results that researchers involvement in on-farm trials is not upto the expectations. Conduct of on-farm trials is an important activity in the process of research and lot of emphasis was given to conduct on-farm trials in the NARP. However, meagre percentage of researchers were personally involved. How the researchers did not involve themselves in conduct of trials is a matter of surprise for all concerned.

The significant variation in involvement of others in on-farm trials in different stations indicated that different researchers had different perception with regard to the involvement of others in conduct of on-farm trials. There was also significant reaction of farmers with regard to on-farm trials. This may be due to improper conduct of trials. The data also indicated that there was significant difference regarding the action taken on the feed back of extension personnel and farmers. These variations indicate that the researchers were not clear regarding who was to do what with regard to on-farm trials, what to inform and what not to inform to the farmers and what action to be taken on the feed back received from extension personnel and farmers regarding on-farm trials.

Documentation, publication and presentation of research results

The H value (4.28 NS) indicated that there was no significant difference among the researchers in documentation, publication and presentation of the research results. The chi-square values indicated highly significant difference among the researches in documentation, publication and presentation of research results in different forms like writing report, computerisation, presentation of the results in ZREAC meeting and there was no difference among the researchers in presentation of research results in publication and presentation in seminars (Table 4).

Majority of researchers documented their research results in the form of reports (73.78%) (Table 4) where as Sabarathnam (1987) reported it was 86 per cent in his study. Sreedhar (1989) also observed the same. More than sixty per cent of the researchers presented in ZREAC meetings, 28.15 per cent of researchers published the research reports and 20.38 per cent presented in the seminars. Less number, 10.67 per cent of the researchers computerised the research results.

It can be concluded that majority of researchers documented their research results in the report form and presented in ZREAC meetings. Few of them published and presented in seminars. There was difference among the researchers in utilization of different activities like report writing, computerisation and presentation in ZREAC meetings.

The study indicated that the participation of researchers in different activities while conduct of experiment was high, but their participation in layout of experiment, recording observations and use of computer is less. The authorities concerned may direct the scientists to involve intensively in the above said activities. The researchers participation in on-farm trials was very less. Hence, authorities should take necessary measures to involve the scientists in on-farm trials so that, it will enable them to refine and modify technologies that will lead to more adoption by the farmers. The authorities may provide training facilities to the researchers in the use of computers.

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Influence of Moisture Content of Groundnut on The Performance of Peg Type Thresher

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ABSTRACT

The working performance of commercially available peg type groundnut thresher was studied with groundnut crop (Cv. TMV - 2) at different days after harvest of the crop. The capacity of the thresher, threshing efficiency, cleaning efficiency, broken percentage and the germination percentage were studied. The results revealed that threshing of crop within 5 days after harvest is found to be better in respect of threshing efficiency and capacity. No impact was observed on the germination of the seed by the use of the thresher.

Key Words : Groundnut, Peg type thresher, Moisture content, Performance, Germination.

Groundnut is one of the important oilseed crops in India. This is grown in 8.4 million ha with a production of 8.20 million tons throughout India. (Desai *et al.*, 1999). It is mostly grown under rain fed conditions and partly in irrigated areas. In Andhra Pradesh, this crop is cultivated on 2.2 million ha covering the districts of Anantapur, Chittoor, Kurnool, Cuddapah and Prakasam. Particularly in Anantapur district itself, this crop is grown in about 8 lakh ha with annual production of 9.04 lakh tons.

After the groundnut crop is harvested, it is heaped and the stripping of pods from the plants is done manually after a period of one month or sometimes more depending upon the availability of labour. During this time the crop is subjected to sucking pests and damage occurs to groundnut kernels. Threshing / stripping of groundnut crop is time consuming, laborious and cost intensive. To overcome these difficulties, now-a-days, commercial threshers are gaining popularity in place of traditional system of threshing / stripping. A simple comb type hand stripper and pedal operated stripper are also available and are being used for bunch type groundnuts. A drum type groundnut stripper developed by TNAU, Coimbatore can strip 150 kg pods by a woman labourer in a day of 8 h (Desai *et al.*, 1999). The use of these threshers eliminates human drudgery and avoids the field losses with timely operations.

MATERIAL AND METHODS

The commercially available peg type groundnut thresher (throw-in-type) was evaluated at Agricultural Research Station, Anantapur to known the working performance of the thresher at different stages of moisture levels after the crop is harvested. The threshing operation was performed with groundnut crop (cv. TMV - 2) on the first day, 3rd day, 5th day, 10th day, 15th day, 30th day and 40th day after harvest. A quantity of 5-7 kg groundnut crop is fed into the thresher with the help of baskets. The observations like moisture content of pods and haulms and performance details like threshing efficiency, cleaning efficiency, broken percentage

Table : Performance details of groundnut thresher

S.No.	Treatment	Moisture content (%) (w.b.)		Threshing effiency (%)	Cleaning effiency (%)	Broken (%)	Capacity (Kg /h)	Germinatin (%)
		Pods	Haulms (%)					
1	T1 : 1st day after harvest	40.36	42.37	97.0	97.0	12.87	300	82
2	T2 : 3rd day after harvest	30.60	40.41	95.8	98.3	15.88	240	84
3	T3 : 5th day after harvest	19.16	38.44	96.4	98.4	15.77	250	90
4	T4 : 10th day after harvest	18.52	29.37	92.0	96.3	14.48	270	85
5	T5 : 15th day after harvest	15.40	26.29	93.2	94.1	14.68	190	84
6	T6 : 30th day after harvest	10.62	20.35	96.9	95.0	16.70	200	84
7	T7 : 40th day after harvest	10.12	10.40	96.1	96.7	18.78	200	93

and capacity were studied. The cost of operation was also calculated. The experiments were replicated thrice and the mean values were reported.

The moisture content was calculated by oven dry method (temp 80 ± 1°C for 24h) and represented on wet basis. The performance details of the thresher were calculated as per standard formulae. The threshed groundnut pods were also tested for germination to see the impact of the machine on the viability of the seed. The germination test was conducted as per standard procedure between paper towels (Anonymous, 1985).

Threshing efficiency = 100% - unthreshed pods

Cleaning efficiency = (quantity of clean pods / total quantity of pods) x 100

RESULTS AND DISCUSSIONS

The performance details of groundnut thresher are furnished in the table 1. The moisture content of the pods and haulms varied from 40.36 to 10.12% and 42.37 to 10.40%, respectively from first day after harvest through 40th day after harvest. The capacity of the machine ranged from 300 to 190 Kg/h (0.30 to 0.19 ha/h), the threshing efficiency from 97.0 to 92.0% and cleaning efficiency from 94.1 to 98.4% and broken percentage from 12.87 to 18.78%, respectively. The seed germination varied from 82 to 93%. The cost of operation of thresher was arrived to be Rs. 56.00 per h (or) Rs. 243.00 per ha (Annual Report, 2000; Annual Report 2001).

The moisture content of the pods and haulms reduced gradually due to passage of time and continuous exposure to the atmosphere in the field itself. The capacity of the thresher was found to be more in the initial threshing operation (300 Kg/h) and reduced gradually to 190 Kg/h. This might be due to drying of pods and haulms and difficulty in handling the crop to feed into the thresher. No significant difference was observed in the threshing efficiency, however, this might be due to uneven manual feeding of crop into the thresher. The cleaning efficiency increased gradually due to excess drying of pods and haulms.

The highest broken percentage was observed in the operation of 40th day after harvest due to more beating impact of the pegs on the dried pods having 10.12% moisture content. As seen from the germination percentage of the groundnut kernels, it could be understood that the threshing operation could not have any impact on the viability of the kernels as all the treatments have the germination of more than 80 per cent. Similar results were obtained in soybean crop threshed at 3,10 and 20 days after harvesting with germination above 80.0 per cent (Yadav and Sharma, 2000).

In view of the above results, it is advisable to thresh the crop immediately after harvest within a period of 5 days (m.c. of haulms between 35 - 40 %) so as to achieve highest threshing efficiency as well as capacity and to reduce broken percentage and also to avoid other field losses. The early threshing operation will also fetch the farmer to catch highest market price during the crop season. The expenditure to be incurred on transport of the crop from the field and heaping can be avoided by use of these threshers immediately after harvest.

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Determination of Equilibrium Moisture Content of Raw and Parboiled Wheat with Computer Aided Analyses

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ABSTRACT

Equilibrium moisture conten (EMC) data for raw, parboiled and bran were obtained by equilibrating them at 10 to 80% relative humidity (ERH) at each of the temperatures of 30, 35 and 40°C by using saturated salt solutions of various inorganic salts. Three EMC - ERH models namely modified Henderson, modified Chung - Pfost and modified Oswin were fitted to the observed data and were evaluated using computer package known as COSTAT which gives predicted values, mean relative per cent error and standard error of estimate values. At a constant relative humidity, equilibrium moisture content decreased with increasing temperature. The Chung - Pfost model described the EMC data the best, modified Henderson and modified Oswin equations gave good fit.

Key Words : Equilibrium moisture content, Relative humidity, Temperature, Raw, Parboiled, Wheat, Bran.

MATERIAL AND METHODS

Sample preparation

The *Kalyan Sona* variety of wheat of proper maturity procured from the local market was used for this study. The wheat was cleaned by screening to remove foreign matter, brokens, chaff and immature grains.

Raw wheat bran had been prepared by polishing cleaned sound raw wheat in satake laboratory rice polisher. Parboiled wheat prepared by soaking at 70°C for 30 min and at pressure of 1 Kg/cm^2 steaming for 20 min. Polishing was done as and when necessary. The samples were dried to 10-11% (d.b.) moisture level in an oven at 50°C.

Eight different salt solutions namely, lithium chloride, potassium acetate, magnesium chloride, potassium carbonate, sodium nitrate and ammonium sulphate were prepared to maintain different relative humidities in desiccators. It was necessary that some of the solid salt was always present in the solution.

EXPERIMENTAL PROCEDURE

The static gravimetric method was used for determination of equilibrium moisture content of raw, parboiled wheat and bran for sorption studies. Saturated solutions of various inorganic salts were employed (Greenspan, 1977) to generate the controlled humidities ranging from 10 to 80% (8 levels) in a closed chamber. Studies of sorption process were carried out at three temperatures of 30, 35 and 40°C for raw, parboiled wheat and their bran.

Eight glass desiccators were used for this study. Each desiccator was provided with a perforated and raised platform and the level of saturated salt solutions in it was kept below the perforated platform in order to avoid contact of the salt solutions with the sample holder. For each of these experiments about 1 g sample of wheat was taken separately into the respective weighing bottles. The desiccator lid was placed. All these eight desiccators were put in an incubator and the gain or loss in weight of all these samples in each desiccator was monitored periodically until two consecutive readings were same. This took about 35 - 40 days, depending upon the nature of the samples. Two replications were kept for each sample and average values of EMC have been reported.

The moisture of a wheat sample was determined by drying of sample in an oven at 105 + 1°C for 24 h (Araullo *et al.*, 1976). The samples were weighed on a precision electronic balance having least count of 0.001 g. Moisture content was calculated by the loss in moisture per unit weight of bone dry material.

Moisture Sorption Isotherm Models

Three isotherm models were used to explain EMC - ERH data for raw, parboiled wheat and bran reported to be better fit for grains.

Modified Henderson equation

The original equation was empirically developed by Henderson (1952) and found a lot of practical application in grain storage and drying. It was modified by Thompson *et al.* (1968). This model is good for starchy grains and fibrous materials (Chen, 1989). Modified Henderson equation (Thompson *et al.*, 1968) is in the form

$$1 - RH = \exp[-A(T+C)M^B]$$

where,

RH = relative humidity, fraction

M = moisture content, % d.b.

T = temperature, 0°C

A,B and C = product constants

Modified Chung - Pfost equation

This was developed by Chung and Pfost (1967) on an assumption that change in free energy for sorption is related to the moisture content. For better - fit Pfost *et al.* (1976) modified the equation by adding a new parameter to the term. This model gives good fit for fibrous and starchy materials. Modified Chung - Pfost equation has the form

$$RH = \exp[-A/(T+C)\exp(-BM/100)]$$

where,

RH = relative humidity, fraction

M = equilibrium moisture content, % d.b.

T = temperature, °C

A, B and C = product constants

Modified Oswin equation

Oswin (1946) developed a model, it was modified by Chen and Morey (1989). Starch containing food and dried milk products have also shown to be well described by this model. It has the form

$$RH = \frac{1}{[\{(A+B\times T)/M\}^c + 1]}$$

where,

RH = relative humidity, fraction

M = moisture content, % d.b.

T = temperature, °C

A, B and C = product constants

RESULTS AND DISCUSSION

Sorption Characteristics

The figures 1 through 4 show the isotherms of raw, parboiled and bran. The sorption behaviour of wheat and bran was dependent on temperature at any relative humidity. The average values of the equilibrium moisture content (EMC) of raw, parboiled wheat and bran measured at different temperatures and

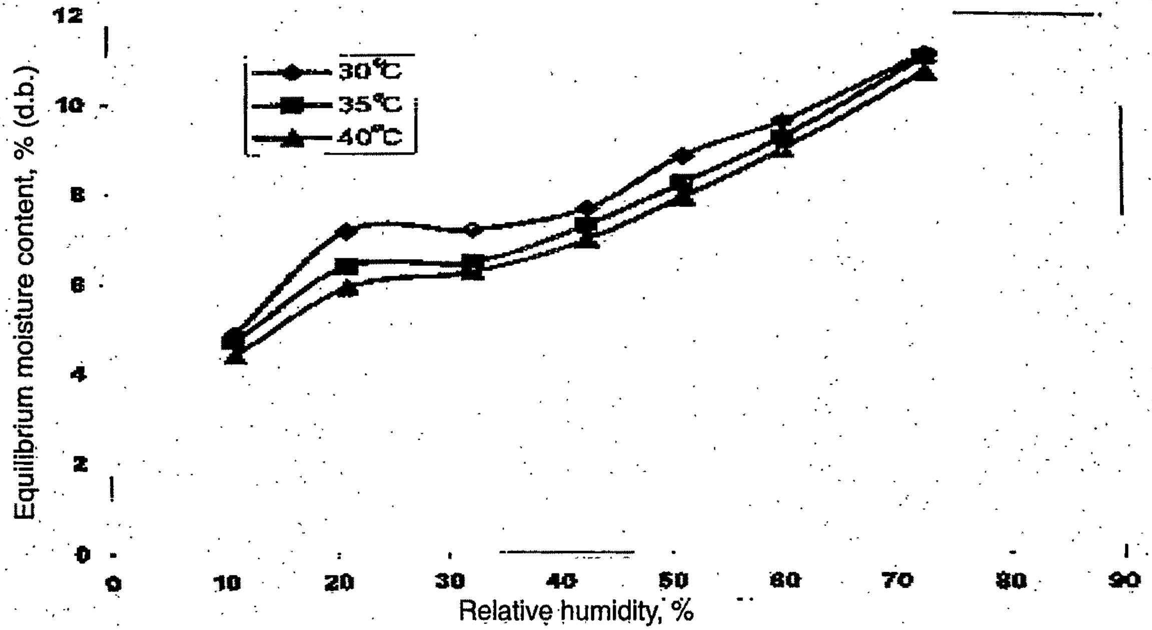

Fig. 1 Typical sorption isotherms of raw wheat

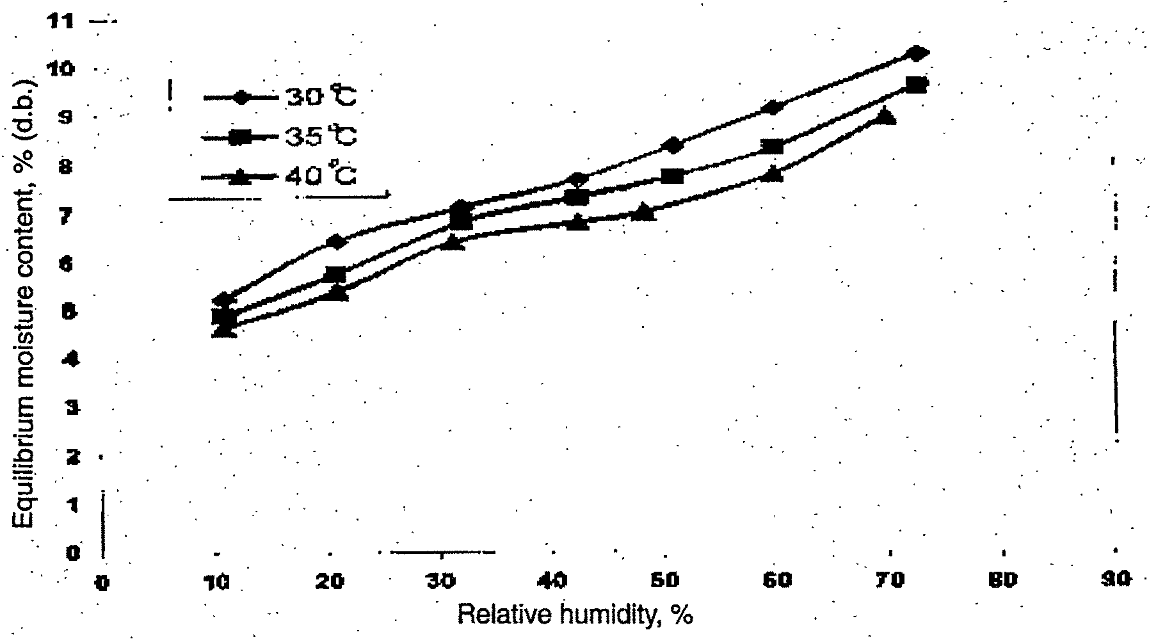

Fig. 2 Typical sorption isotherms of parboiled wheat

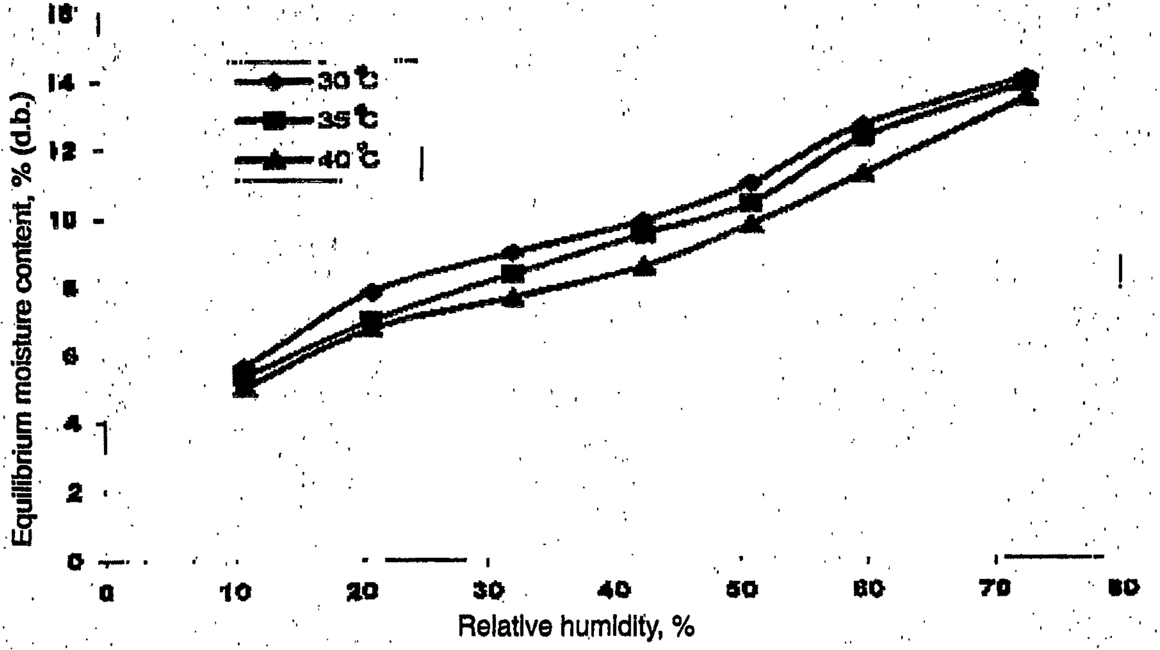

Fig. 3 Typical sorption isotherms of raw wheat bran

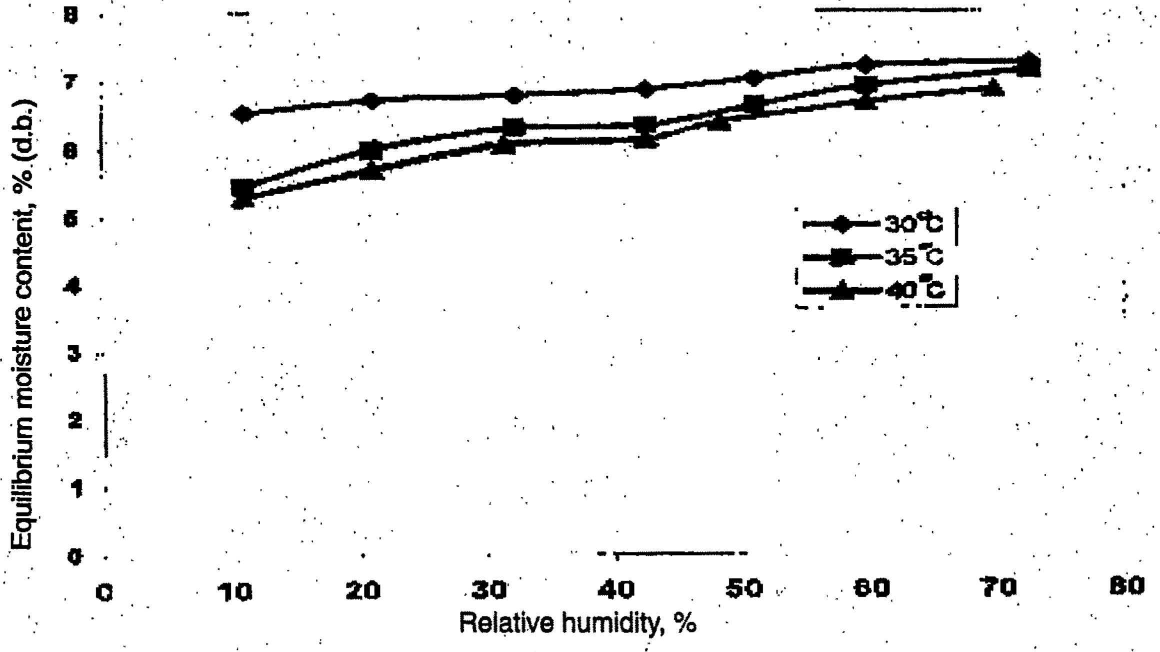

Fig. 4 Typical sorption isotherms of parboiled wheat bran

Table : The coefficients of modified Henderson, modified Chung-Pfost and modified Oswin for the raw, parboiled wheat and bran.

	Coefficients			
	A	B	C	R^2
Raw wheat				
Henderson	0.0750	-1.1101	2.0510	0.9910
Chung - Pfost	15.810	-11.712	2.8460	0.9410
Oswin	-2.5852	0.3807	4.1481	0.9567
Parboiled wheat				
Henderson	0.0750	-1.1101	2.0510	0.9910
Chung - Pfost	16.0123	-12.562	2.9234	0.9900
Oswin	-4.1467	0.4290	4.1945	0.9891
Raw wheat bran				
Henderson	0.0750	-1.1101	2.0510	0.9910
Chung - Pfost	19.7206	-16.7847	4.3746	0.9716
Oswin	-1.9495	0.3965	3.0033	0.9793
Parboiled wheat bran				
Henderson	0.0750	-1.1101	2.0510	0.9910
Chung - Pfost	8.0183	-12.328	0.4059	0.9797
Oswin	-27.6418	1.1552	27.4228	0.9682

relative humidities are presented. The EMC at an equilibrium relative humidity (ERH) decreased with the increase in environmental temperature. Higher the temperature, higher is the kinetic energy of the water molecules and therefore, lower is the water absorbed at a given water activity. Parboiled wheat showed lower EMC values than raw wheat, parboiled bran has also shown lower EMC values at all temperatures and equilibrium relative humidities compared to parboiled wheat bran (Swamy, 2001).

Modeling of sorption isotherms

The coefficients of the modified Henderson, modified Chung - Pfost and modified Oswin are presented in Table. The high correlation coefficients clearly indicate that all the above EMC models tested are in good agreement with the experimental data.

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Research Note

Nursery Treatment with Imidacloprid 200 SL is Safe to Predators in Rice Ecosystem

Imidacloprid 200SL, a new molecule belonging to chloronicotinyl group is being widely used in rice ecosystem for the control of leaf and plant hoppers and other sucking pests in Andhra Pradesh. In addition its application as seed treatment in cotton is popular in cotton growing areas and is being widely used. Hence, a study was undertaken involving different treatments (Table) of imidacloprid 200 SL applied in nursery before pulling, against the activity of predators in main field after planting.

Table : Effect of imidacloprid 200 SL on the of predators in rice ecosystem.

Treatment	Time of treatment	Concentration %/g.a.i/ha	45 DAT				60 DAT			
			Spiders	Dragon files	Cocci-nellids	Total	Spiders	Dragon files	Cocci-nellids	Total
Sprouted seed soakig	3hr BS	0.05%	1.5 (7.9)	1.7 (7.0)	1.2 (6.8)	4.4 (12.7)	0.7 (6.3)	0.7 (6.3)	2.0 (9.0)	3.4 (11.8)
Sprouted seed soaking + drenching	5 DBP	75 g	1.2 (7.2)	2.0 (6.8)	2.5 (9.3)	5.7 (13.9)	1.0 (7.0)	1.0 (6.8)	3.0 (10.7)	5.0 (13.5)
Soil application	10 DBP	25 g	1.2 (7.2)	1.2 (6.8)	2.0 (9.0)	4.4 (12.7)	0.7 (6.0)	1.0 (6.8)	2.2 (8.9)	3.9 (10.7)
Soil application	10 DBP	37.5 g	1.7 (8.5)	2.7 (7.0)	2.2 (9.4)	6.6 (15.5)	1.0 (7.0)	1.0 (7.0)	2.5 (9.9)	4.5 (12.9)
Foliar application	5 DBP	25 g	1.2 (7.2)	1.0 (6.8)	1.7 (8.1)	3.9 (10.7)	0.7 (6.0)	1.0 (6.8)	2.0 (9.0)	3.7 (10.5)
Foliar application	5 DBP	37.5 g	0.7 (6.3)	1.5 (8.0)	1.5 (8.0)	3.7 (11.7)	1.2 (7.5)	1.5 (8.0)	2.0 (9.0)	4.7 (13.1)
Carbofuran 3G	5 DBP	1.5 kg	1.5 (7.8)	1.5 (8.0)	1.2 (7.2)	4.2 (12.1)	0.5 (5.5)	1.2 (8.0)	2.0 (8.9)	3.7 (11.8)
Untreated control	-	-	0.5 (2.2)	1.0 (5.5)	1.7 (8.1)	3.2 (10.7)	1.0 (6.4)	0.5 (5.5)	2.5 (9.8)	4.0 (11.8)
S.E±	-	-	NS	NS	NS	NS	NS	NS	NS	NS
C.D (5%)										

The values in the parentheses are angular values.
BS - Before sowing; DBP - Days before pulling; DAT - Days after transplanting.
NS - Non significant

Tellahamsa, a popular rice variety susceptible to many pests was planted at 15 x 15 cm spacing at Agricultural Research Institute, Rajendranagar, ANGRAU, Hyderabad during *kharif* 1999. A total of eight treatments were included with four replications in randomised block design and the data obtained were subjected to angular values and analysed statistically (Table). Carbofuran 3G was used as check. The population of spiders, dragonflies and coccinellids were recorded by sweepnet method at 45 and 60 DAT (days after transplantation).

Maximum predator population was recorded in sprouted seed soaking and drenching @ 75 g a.i. / ha at 5 DBP (5.0 predators / plot) followed by foliar application @ 37.5 g.a i./ha at 5 DBP (4.7 predators / plot). The total population was less (3.4predators / plot) at 60 DAT and more (6.6 predators / plot) at 45 DAT. There were variations of populations of spiders, dragonflies and coccinellids in different treatments at both 45 and 60 DAT. But the data were statistically non - significant. The results (Table) showed that there were no variations in the activity of spiders, dragonflies and coccinellid population at 45 and 60 DAT in different treatments of the test insecticide (Table). It indicated that application of imidacloprid in the nursery did not show any adverse effect on the activity of spiders (*Lycosa* sps and *Argiop* spp), dragonflies (*Cardulia aenea*) and coccinellids in the main field after planting.

Lixin and Tianxi (1995) reported non-significant effect of imidacloprid 200 SL @ 408 g.a.i./ha on spiders in rice. Hopkins and Donaldson (1996) also proved imidacloprid as safe to beneficial insects on cotton. No adverse effect of imidacloprid was observed on beneficial arthropods (Pollini and Bariselli, 1997).

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Research Note

Apanteles angaleti a Larval Parasite in The Control of Pink Bollworm, *Pectiniphora gossypiella* (Saunders) in Cotton

Among the several pests that attack cotton from sowing to harvest, about a dozen pests cause economic damage as sap feeders and bollworms in different parts of the country. Among the bollworms, the pink bollworm, *Pectinophora gossypiella* (Saunders) is more serious and not accessible to insecticide sprayings. The pest activity was found to be continuing even after harvest causing upto 35 per cent yield loss, while the country's loss due to this pest was estimated at 6525 metric tonnes of lint worth Rs. 1216 millions (Agarwal and Katiyar, 1979).

Long ago, Simwat and Sindhu (1982) reported *Apanteles angaleti* playing a significant role in causing mortality of diapausing larvae. However, Gong *et al.* (1984) observed that *Bracon nigrorufum* was a potential biocontrol agent for pink bollworm larvae, whereas Pawar and Prasad (1985) observed 8.3 - 15.0 per cent parasitisation by *Bracon kirkpatricki* during March in the pink bollworm larvae collected from cotton stalks stored near the fields. Surulivelu (1989) reported that the incidence of *Apanteles angaleti* on *P. gossypiella* was the greatest in February and declined considerably in the subsequent months upto May, although pink bollworm incidence showed a significant increase. Realising that most of the abiotic weather factors are not playing any major regulatory role in restricting pink bollworm build up and the pest on the otherhand, is steadily increasing in numbers on cotton in Andhra Pradesh, survey of cotton ecosystem was taken up for identifying the existing biocontrol agents that are active in suppressing pink bollworm on cotton.

The incidence of biocontrol agents was recored in the field conditions through periodical sampling of fruiting bodies in a bulk cotton crop during 1998 - 99 season at the Regional Agricultural Research Station, Lam, Guntur. Larvae parasitised by biocontrol agents were collected from the field and kept in rearing cups in the laboratory and observed for the emergence of bio-agents from the parasitised larvae. The data on parasitised larvae were pooled and per cent parasitisation of pink bollworm larvae by *A. angaleti* was worked out.

Regular sampling of damaged bolls particularly for the incidence of biocontrol agents has revealed the presence of larval parasite *A. angaleti.* The field collected pink bollworm larvae when reared in the laboratory from 20th January to 20th April, 1999 revealed 4.0 to 17.6 per cent larval parasitisation under field conditions (Table).

Table : Extent of parasitisation of pink bollworm larvae by *Apanteles angaleti* on cotton during 1998 - 99

Date	No. of larvae observed	No. of larvae parasitised	Per cent parasitisation
20 - 1 - 99	29	4	13.7
20 - 2 - 99	34	6	17.6
20 - 3 - 99	37	4	10.8
20 - 4 - 99	24	1	4.0

Parasitisation of pink bollworm larvae by *A. angaleti* could be observed only during the period of peak activity of pink bollworm from the middle of January till the middle of April. The per cent parasitisation of pink bollworm larvae during this period varied from 4.0 per cent (April, 1999) to the maximum of 17.6 per cent (February, 1999). The larval parasitisation drastically declined from the middle of March coinciding with high temperatures.

The survey results revealed that the pink bollworm larval parasitisation by *A. angaleti* alone was prevalent during the period of peak activity of pink bollworm from the middle of January till the middle of April. Contrary to this finding, several workers listed many parasites and predators affecting pink bollworm incidence in cotton and the list includes *Collops vittatus, Hippodamia convergens* and *Chrysopa carnea, Nabis* spp., *Sinea confusa, Geocoris* spp., and *Orius tristicolor* (Henneberry and Clayton, 1982), *Bracon nigrorufum* (Gong *et al.*, 1984), *Pyemotes ventricosus* (Naresh and Balan, 1985), *Trichogramma brasiliensis, Chelonus blackburni* and *Bracon kirkpatricki* (Prasad *et al.*, 1985), *Dibrachys* spp., (Hekal, 1990), *Trichogrammatoidea bactrae* (Naranjo, 1993) and *Acanthaspis pedestris* (Sahayraj and Ambrose, 1994).

The observation of *A. angaleti* late in the season causing 4.0 to 17.6 per cent parasitisation in pink bollworm larvae can be attributed to heavy application of insecticides till the end of December on cotton mainly for control of American bollworm, *Helicoverpa armigera*. Further, the steep fall in the parasite activity noticed by April month may be due to appreciable rise in temperature which is in line with the observations of Surulivelu (1989).

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Research Note

Effect of Slow Release Nitrogenous Fertilizers on Growth and Yield of Cassava

Nitrogenous fertilizers play a vital role in augmenting the yield of cassava. Nitrogenous fertilizers, especially urea is subject to various losses. The use of slow release nitrogen fertilizers and biological Inhibitors which inhibit the nitrogen activity in the soil are very effective methods for improving the nitrogen efficiency.

Prasad and Reddy (1977) observed that coating the fertilizers with materials like oil cakes, plastic and other inert materials leads to slow release of the fertilizers. Prasad (1979) reported that the use of urea super granule gave higher fertilizer nitrogen efficiency than ordinary urea. Vinod and Nair (1992) reported that urea super granules and neem cake coated urea enhanced the growth characters of cassava and confirmed that the starch yield and hydrocyanic acid (HCN) contents were not affected by the slow release of nitrogen while higher levels of nitrogen application increased the hydrocyanic acid content.

In order to study the effect of slow release nitrogen sources on cassava, an experiment was taken up under A.I.C.R.P. on Tapioca (other than potato) at Agricultural Research Station, Peddapuram during the years 1993 - 1994 and

Table : Effect of Slow Release Nitrogen Fertilizers on Cassava

S.No	Treatment	Total population	Plant Height (cm)	No. of Branches	Stem girth (cm)	Tuber length (cm)	Tubers per plant	Tuber yield per plot	Tuber yield T/ha
1.	Prilled urea	19	275	2	2,66	25.4	7.8	25.6	15.8
2.	Urea super granules	20	279	2	2.6	23.5	7.5	21.2	13.0
3.	Neem coated urea	19	301	2	2.7	28	10	28.1	17.4
4.	Sulphur coated urea	20	3.7	2	2.6	25.5	8	23.6	14.6
5.	Tar coated urea	19	299	2	2.6	26	9.8	22.6	13.95
6.	Control (No urea)	19	277	3	2.0	24.4	9.5	22.5	14.1
	SEM for T	NS	NS	NS	NS	0.4486	0.4736	0.4532	
	CD					1.35	1.427	1.37	
	SEM of plot					0.8971	0.9472	0.9064	
	CV%					3.5	10.9	3.8	

1994 - 1995. The variety used for the trial was H-226. The treatments consisted of five sources of urea namely prilled urea, urea super granules, neem coated urea, sulphur coated urea and tar coated urea. The experiment was laid out in randomized block design with three replications. Recommended quantity of fertilizer was assessed and applied to supply the required dose of 60 N/ ha besides the regular 60 P and 60 K/ha.

The growth characters like plant height, number of branches and stem girth were non-significant with the treatments. However, the neem coated urea recorded the highest tuber length (28cm), total number of tubers per plant (10) and the total tuber yield (17.4 T/ha) followed by prilled urea treatment with yield of 15.8 T/ha. Hence it is concluded that neem coated urea may be recommended for cassava to get maximum net returns (Table).

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Research Note

Comparative Benefit - Cost Ratio of Manual Weeding and Herbicide use in Direct Seeded Rice

One of the major causes of low yields of direct seeded rice is, inadequate weed control measures. Although hand weeding is very effective, it is laborious, time consuming and expensive due to high cost of labour, particularly during peak period of requirement. For such reasons usage of herbicides and their combinations proved to be advantageous and are becoming popular in many rice growing areas of the country. Herbicide combinations can control wide range of weed species than single herbicide treatments and the effective control lasts longer than that of single herbicide treatments (Moody, 1982; Ravichandran, 1993). The present investigation was therefore carried out to assess the cost effectiveness of herbicide alone and combinations compared to manual weeding in direct seeded rice.

Field experiment was conducted at the Agricultural College Farm, Bapatla during *kharif*, 1999 with 11 treatments (Table) laid out in randomised block design with three replications. The experimental field was sandy clay loam in texture, slightly alkaline in reaction, low in available nitrogen and phosphorus and high in potassium. All the herbicides were applied on 7th day after sowing. The other cultural operations except weeding were common to all the treatments. The cost of cultivation of each treatment was calculated and recorded. The net returns due to herbicide treatments and hand weeding over unweeded control was worked out on the basis of net returns in terms of rupees after deducting the cost of treatment. The benefit-cost ratio was calculated by using the following formula.

$$\text{Benefit-cost ratio} = \frac{\text{Additional benefit over unweeded check}}{\text{Additional cost over unweeded check}}$$

Economics of various weed control treatments (Table) clearly showed that cost of weeding was maximum with weed free check (Rs. 3960 ha^{-1}) and hand weeding twice. (Rs. 1980 ha^{-1}) compared to other weed control treatments. Among the herbicide treatments, oxadiazon application registered the highest cost (Rs. 1064 to 1440 ha^{-1}), followed by thiobencarb (Rs. 980 to 1040 ha^{-1}). The lowest cost of weeding was obtained with pretilachlor (Rs. 500 to 555 ha^{-1}) which led to lower total cost of cultivation.

Among all the weed control treatments, weed free check gave additional net return of Rs. 5426/- per hectare over unweeded check, whereas, herbicide treatments *viz.*, butachlor + 2,4 - DEE gave the highest additional net return of Rs. 5635/-, followed by oxadiazon + 2,4 - DEE with an additional net return of Rs. 5580/-. These two treatments were superior to weed free check. Thiobencarb alone at 1.5 kg ha^{-1} gave less net returns than unweeded check, due to crop injury

Table : Economics of weed control treatments in direct seeded low land rice.

Treatments	Total cost of cultivation (Rs. ha^{-1})	Additional cost of inputs over T_{11} (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	Additional net returns over T_{11} (Rs. ha^{-1})	Benefit - cost ratio
Butachlor @ 2.0 Kg a.i. ha-1	9410	900	20533	11123	2722	3.02
Butchlor + 2,4 - DEE @ 1.5 Kg a.i. + 0.4 Kg a.i. ha-1	9385	875	23421	14036	5635	6.44
Pretilachlor @ 1.0 Kg a.i. ha^{-1}	9010	500	18685	9675	1274	2.54
Pretilachlor + 2,4-DEE @ 0.75 Kg a.i. + 0.4 Kg a.i. ha^{-1}	9065	555	21226	12161	3760	6.77
Oxadiazon @ 0.5 Kg a.i. ha^{-1}	9950	1440	21512	11562	3161	2.19
Oxadiazon + 2,4-DEE @ 0.3 Kg a.i. + 0.4 Kg a.i. ha^{-1}	9574	1064	23931	13981	5580	5.24
Thiobencarb @ 2.0 Kg a.i. ha^{-1}	9550	1040	17278	7778	-673	--
Thiobencarb + 2,4-DEE @ 1.5 Kg a.i. + 0.4 Kg a.i. ha^{-1}	9490	980	20487	10997	2596	2.65
Hand weeding at 20 and 40 DAs	10490	1980	24107	13617	5216	2.63
Weed free check	12470	3960	26297	13827	5426	1.37
Unweedy check (control)	8510	--	16911	8401	--	--

Cost of herbicides :		Price of paddy	1 q = Rs. 470/-
Butachlor (G) :	Rs..22.5/- per Kg.	Price of straw	1 q = Rs. 100/-
Pretilachlor EC :	Rs. 250/- per lt.	Urea	1 Kg = Rs. 4.20/-
Oxadiazon EC	Rs. 720/- per lt.	SSP	1 Kg = Rs. 2.95/-
Thiobencarb EC	Rs. 260/- per lt.	MOP	1 Kg = Rs. 3.80/-
2,4-DEE (G)	Rs. 22.5/- per Kg.	ZnSO$_4$	1 Kg = Rs. 22.50/-
		Labour wage	Rs. 44.50/- per day

during early stages and of weed dominance at the later stages of the crop, resulting in reduced yields. The Benefit - cost ratio, for the all herbicide treatments except thiobencarb was higher over the weed free check. Higher benefit-cost ratio (6.77) was obtained with pretilachlor + 2,4-DEE followed by butachlor + 2,4-DEE (6.44).

Although oxadiazon + 2,4 -DEE was the most effective treatment in recording higher yields, weed control efficiency and additional net returns showed lower benefit-cost ratio (5.24), because of its relatively higher cost compared to other herbicides used. Lowest benefit - cost ratio in case of weed free check was due to more labour cost. Similar results of lower benefit - cost ratio with pendimethalin + 2,4 -D Sodium salt, was also reported by Bhera and Jena (1998). The present investigation indicated that combined application of either pretilachlor or butachlor with 2,4-DEE was quite effective and economical for direct seeded rice.

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Research Note

Agronomic Evalution of Blackgram Under Rainfed Condition in Krishna - Godavari Zone of Andhra Pradesh

A field experiment was conducted during *kharif* 1996 at the Regional Agricultural Research Station, Lam, Guntur (Andhra Pradesh) to assess relative performance of four blackgram varieties to varying dates of sowing and row spacings under the Agro-climatic conditions of K.G. Zone of Andhra Pradesh. The soil of the experimental field was clayey in texture. The chemical analysis of the experimental soil revealed that it was, low in available N, medium in available P and high in available K with pH of 8.1. A basal dose of 20 kg N and 50 kg P_2O_5 ha^{-1} was applied in furrows at the time of sowing. Treatments consisted of combination of sowing (10-7-1996 and 1-8-1996) and two row spacings (30 and 45cm.) as main plots and four varieties (AKU 7, LBG 623, PU 19 and PU 94 - 2) as sub-plots, replicated twice in a split-plot design. The crop was harvested on 28-9-1996 and 27-10-1996 under respective dates of sowing. During the crop season 760 mm rainfall in 34 rainy days was received.

Table 1 : Yield attributes and yield of blackgram as influenced by dates of sowing, spacing and varieties.

Treatment	Plant height (cm)	No. of pods/ plant	No. of seeds / plant	100 Seed weight (g)	Seed yield (kg ha^{-1})
Date of sowing					
D1 - 10 - 7 - 96	36	19	5.9	3.62	784
D2 - 1 - 8 - 96	19	9	4.1	3.62	172
C.D. (0.05)	2.5	2.3	0.4	NS	37
Spacing					
S1 - (30 x 10 cm)	26	12	5.0	3.62	513
S2 - (45 x 10cm)	29	16	4.9	3.61	443
C.D. (0.05)	NS	2.3	NS	NS	37
Varieties					
V1 - AKU 7	32	18	4.9	3.51	573
V2 - LBG 623	28	11	4.8	3.96	381
V3 - PU 19	21	12	5.0	3.32	398
V4 - PU 94 - 2	29	16	5.2	3.67	559
C.D. (0.05)	3.4	3.3	NS	0.27	48
Interaction					
D x V	NS	NS	Sig.	NS	Sig.
S x V	NS	NS	Sig.	NS	NS
D x S x V	NS	NS	NS	NS	Sig.

NS - Non - significant

The results of the experiment revealed that the seed yield under late sown conditions was significantly reduced compared to normal date of sowing. The reduction in yield was to the extent of 78 per cent under late sown conditions (Table 1). Similar findings were also reported by Nema *et al.* (1989).

The effect of row spacings differed significantly in respect of yield attributing characters like number of pods per plant and grain yield. This might be due to the difference in plant stand that makes all the differences. The closer row spacing gave higher plant stand and contributed more grain yield though the number of pods were low. On the other hand, the higher yield attributes at wider spacings were not enough to compensate higher yield recorded with closer spacings. Borah (1994) and Nema *et al.* (1989) reported 30 x 10 cm spacing as optimum. The highest seed yield recorded by the variety AKU7 was significantly superior to LBG 623 and PU 19 but was at par with PU 94 - 2. The lowest seed yield was recorded by LBG 623. A significant interaction of dates and varieties, and also dates, spacings and varieties was observed. AKU 7 performed well under normal sowings, whereas PU 94 - 2 did well under late sown condition (Table 2). The significant decrease in seed yield was noticed with AKU 7 and LBG 623 under wider row spacing in normal sowing date but no variety recorded any significant reduction in grain yield under delayed sowing even under wider spacing (Table 3).

Table 2 : Interaction effect of dates of sowing and varieties on grain yield of blackgram.

Treatment	V_1	V_2	V_3	V_4
D_1	1028	649	589	870
D_2	118	113	207	249

C.D. at (0.05) - 68.7

Table 3 : Interaction effect of dates of sowing, spacing and varieties on the yields of blackgram.

Treatment	V_1	V_2	V_3	V_4
D_1S_1	1149	700	590	903
D_1S_2	908	599	589	836
D_2S_1	130	138	242	251
D_2S_2	106	88	172	248

C.D. at (0.05) - 97.2

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Research Note

Breed Efficiency of Crossbred Cow Over Local Cow

Dairy farming, long back has been recognized as an important farm activity for enhancing farmers income levels in our country. It is supplementary or complementary enterprise especially to millions of small and marginal farmers and landless labourers. It is rural based, land saving and gender neutral. Compared to crop production, it offers more favourable opportunities for employment.

Breed exhibited tremendous influence as crossbred cow has the ability of increasing the milk output over local cow. The present study, is therefore, an attempt to examine the breed efficiency of crossbred cow over local cow in influencing milk yield.

The study, was carried out in Chittoor district of Andhra Pradesh for the year 1996 - 97. Multistage random sampling technique was used in this study for the selection of the respondents. All the mandals in the district were arranged in the descending order of their number of milch cattle and top two mandals were purposively chosen for the study. All the villages in the selected mandals were listed out in the descending order of the number of milch cattle and top three villages under each mandal were selected making the total number of sample villages to six. A list of dairy farmers in each selected village was prepared and 12 farmers were selected randomly from each village thus making the total sample size to 72. The primary data on different aspects of the study were collected from the selected respondents for the production period 1996-97 with the help of well structured, pre-tested schedule by survey method.

To estimate the influence of the breed on milk production in cows, multiple linear regression analysis was carried out (Gupta, 1997). The functional form is :

$$Y = a + b_1x_1 + b_2x_2 + \ldots\ldots\ldots\ldots + b_5x_5 + U$$

Where,

Y = Total milk yield in litres

x_1 = Green fodder (Kg)

x_2 = Dry fodder (Kg)

x_3 = Concentrates (Kg)

x_4 = Human labour (man days)

x_5 = Dummy (1 for crossbred cow and 'O' for local cow)

The included variables in the function explained about 73 per cent variation in milk yield obtained from both crossbred and local cows (Table). The variables, green fodder (x_1) and concentrates (x_3) were significant at one per cent level, while the dummy variable for breed was also significant at one per cent level. The elasticity of variable dry fodder (x_2) was negative

Table : Breed efficiency in Milk Production

Item		Estimated values		Standard Errors
Intercept		-743.8165		
Regression Coefficients				
Green Fodder (Kg)	X_1	0.2553***	3.177	0.0804
Dry Fodder (Kg)	X_2	-0.0149	-0.139	0.1076
Concentrates (Kg)	X_3	1.8451***	6.280	0.2938
Human Labour (man days)	X_4	0.1489	0.073	2.0362
Dummy Variable (1 for Crossbred and 'O' for local)	X_5	886.3925***		327.3511
Coefficient of multiple determination	R^2	0.7369***		

*** Significant at 1% level.

but non-significant while that of human labour (x_4) was positive and significant. One unit increase in green fodder and concentrates keeping others constant at their respective mean levels would increase the milk production by 0.25 units and 1.84 units, respectively. Breed exhibited tremendous influence as crossbred cow had the ability of increasing the milk output by 886 litres over local cow.

To recapitulate the results of the study, it can be concluded that crossbred cow has more ability of increasing the milk output compared to that of local cow (Sankhayan and Joshi, 1975 and Reddy Subba and Raghuram, 1994). The variables, green fodder, concentrates and type of breed have significant influence on total milk yield. The study suggests that the local breeds have to be substituted by the crossbreds along with better management of feeding and provision of better cattle health cover.

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Research Note

Rural Consumer Decisions on Branding and Packaging of Food Commodities

Consumers are at the core of any business activity. In the present age of consumer oriented market, branding and packaging have gained unique importance as consumers look for the characteristics such as : quality, safety and continuity of supply under the keen competition of the products in the market. The consumers with pressure of time, are interested in minimizing the risks by seeking an effective means of goods selection. The present paper examines the behavioural reactions of such consumers in relation to branding and packaging of selected food commodities.

Household survey using interview technique constituted the research method for understanding the consumer decisions on branding and packaging of selected food commodities. The locale of the study was limited to Rajendranagar mandal, Ranga Reddy district due to the investigators accessibility and rapport developed in that area. Four villages, *viz;* Budwel, Premavathipet, Sivarampally, Rajendranagar were selected as the consumers enjoy the influence of both rural and suburban markets. Ten households were selected from each of the villages and a total of 40 home makers were interviewed for this purpose. A schedule was developed consisting of 19 questions on socio-economic status.

Socio - Economic characteristics

A comprehensive description of socio - economic characteristics of the sample surveyed is presented in Table - 1. Nuclear families to an extent of 82 per cent with 45 per cent of medium sized and 40 per cent of small sized families represented the group. The influence of urban area was exhibited in the educational attainment of the sample since 32.5 per cent of the respondent were illiterates, 20 per cent were primary school dropouts and 15 per cent were having secondary school education. About 72 per cent of the subjects interviewed were unemployed (Table 1). The mean income per month ranged between Rs.10000 to Rs.15000 for 25 per cent of the sample.

Role of Family Members in Making Consumer Buying Decisions related to Food Commodities

Table -2 indicates the ultimate consumer buyer of food commodities in the market. The principal buyer was seen as the head of family

Table 1: Socio - Economic status of the consumers

N = 40

Socio Economic characteristic	Classification	Number	Percentage
Family size	Small	16	40
	Medium	18	45
	Large	6	15
Family Type	Joint	7	17.5
	Nuclear	33	82.5
Education	Illiterate	26	65
	Primary school	8	20
	Secondary school	6	15
Occupation	Employed	11	27.5
	Unemployed	29	72.5
Income	LIG	5	12.5
	MIG	25	62.5
	HIG	10	25

Table 2 : Participation of Family Members in the Buying of Food Commodities

N = 40

Food Commodity	Husband	Wife	Children	Joint
Wheat atta	15(37.5)	4(10)	2(5)	15(37.5)
Fresh milk	14(35)	7(17.5)	3(7.5)	8(20)
Cooking Oil	15(37.5)	5(12.5)	0	12(30)
Tea	16 (40)	7(17.5)	0	8(20)
Coffee	15(37.5)	6(15)	0	1(2.5)
Chili Powder	17(42.5)	7(17.5)	0	1(2.5)
Turmeric	15(42.5)	6(15)	0	1(2.5)
Masala Powder	16(37.5)	7(17.5)	0	1(2.5)
Pickles	16(40)	8(20)	0	2(5)
Biscuits	19(47.5)	8(20)	0	1(2.5)
Chips	20(50)	15(37.5)	0	5(12.5)

in about 38 to 50 per cent of the households. Home makers participation was seen only within the range of 10 to 20 per cent on an average. Joint buying decisions were taken for the products like wheat atta, milk, cooking oil, tea in less than 38 per cent of households. It was interesting to note that chilli powder, turmeric, masala powders, pickles were bring processed at home itself in 60-70 per cent of households for ensuring good quality. The above buying behaviour indicates the domination of head of the family as major buyer of majority of food commodities.

Preference to Market Outlets

Sixty five per cent of households preferred retail stores for buying food commodities followed by super markets by 32 per cent of families. This shows that rural consumer has larger dependence on retail stores compared to Public Distribution Systems and other market outlets.

Brand Preference of Consumers to Food Commdities

About 50 to 75 per cent households were found to confirm to popular brands while buying commodities like wheat atta, fresh milk, cooking oil, tea & coffee powders and biscuits. However, brand shifting featured in the purchase of turmeric, masala powders, pickless and chips. Seventy per cent of the respondents expressed satisfaction on their brand choice and expressed their desire to continue with the same brand.

Role of Packaging in the Purchase of Commodities

Half of the respondent consumers preferred to buy the food commodities in packaged form. Ease of handling and quality

Table 3 : Ranks given by the Rural Consumers on the Reasons of their Preference to Packed goods

N = 40

Reasons	Ist Rank	IIst Rank	IIIst Rank	Others
Assured quality	14	1	6	19
Right weights & measures	6	10	3	21
Available in Reuired quantity	3	11	4	22
Reusability of the container	3	1	1	35
Ease of handling	11	6	7	16
Quick buying	3	6	7	24
Incentives offered	2	6	2	35
Reputation of the brand	1	1	3	34
Information provided on the lable	3	2	4	32
Attractive apperance of the package	1	1	1	38

assurance were the chief attributes (Table -3). The other attributes that have significant influence for the purchase of food commoities in packed form are correct weight, quick buying, availability of packed foods in the required quantity and quick buying. Attributes like reusability of the container, incentives offered, brand reputation labelled information, attractive appearance of the package were ranked later to the first three levels in priority ranking. This shows that rural consumers are selective and conscious of weighing the different attributes of packaging.

Preference of Consumers to packaging Materials

It was noticed from the survey that polythene was the most common packaging material that was preferred by majority of the respondents for buying commodities like wheat atta, milk, oil, chilli powder, turmeric, masala powderr and chips. However, tea and coffee were preferred in pape cartoon material. The preference for the polythene as the package material was due to the functional attributes like product safety, hygiene, strength, handling and ease of opening. Durability of the container, product visibility, environmental friendliness of the material, economy, attractive appearance were the other reasons for the selection of the packaged commodities (Table 4).

Table 4 : Perference of Consumers on Packaging Mateirals

Food Commodity	Poly ethlene	Plastic	Tin	Glass	Paper	Alu minium foil
Wheat atta	29	1	0	0	0	0
Fresh milk	26	1	0	0	0	0
Cooking Oil	28	0	9	9	0	1
Tea	0	4	0	0	32	2
Coffee	0	1	0	0	25	8
Chili Powder	14	2	0	0	1	1
Turmeric	14	2	0	0	1	1
Masala Powder	13	1	0	0	2	1
Pickles	3	0	0	0	0	3
Biscuits	5	1	0	0	20	10
Chips	27	1	0	0	0	2

Preference of Consumers related to Size of the Packages

Majority of the consumers were purchasing the food commodities like tea powder, coffee powder, chilli powder, turmeric, masala powder, pickles, in the quantity of 250 to 500 grams size. Only wheat atta and cooking oil were preferred in 2 Kg packets. This shows that rural consumers are repeated buyers for the same commodity through out the year.

Problems of the Consumers on Packaged goods

About seventy per cent of the consumers expressed that the food commodities that are packed in polythene bags were subjected to breakages and they needed to check for the same before purchasing. Half of the consumers expressed that store keepers are charging the packaging cost and hence are costlier than unpacked ones. Nearly 30 per cent of the respondents expressed incorrect weights of the foods in packages as their problem. Infestation of the commodity, adulteration of the commodity were the problems faced by 10 per cent of consumers.

It can be understood from the survey that, the head of the family takes most of the buying decisions. Most of the consumers in the rural area preferred to stick to popular branded food commodities as they feel those food items are safe and hence exhibited little interest in shifting from the popular brands. Equal percentage of rural consumers exhibited their interest in buying the food commodities in packed and unpacked forms. However, among the choosers of packed commodities, ligical criteria on quality, right weights were weighed as reasons indicating that the rural consumers are also rational in buying food commodities.

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Research Note

Folk Beliefs Associated with Dairy Farming Among Koyas

The tribals have tried to understand and adjust themselves with the supernatural world, which they believed is infested with many a spirit of varied nature and potentialities. A few of these spirits are considered benevolent while others are malevolent. Some of them have been attributed to the status of deities or God. They believed that elaborate worship and observance of rituals bring success and ward off misfortunes and calamities. Thus, in their traditional ways of life which are now under a process of adjustment, tribals are generally steeped with lots of superstitious and primitive beliefs. They have some such beliefs pertaining to diary farming. Here only superstitious beliefs pertaining to cattle have been considered, as these need to be changed if we expect any dairy development programme to be successful. Out of 33 Schedule Tribal groups of Andhra Pradesh, Koya is the predominant tribal group with unique culture concentrated in the boarder area of Khammam, East Godavari and West Godavari districts of Andhra Pradesh. With this background the present study was organized to analyse the folk beliefs associated with dairy farming among Koyas.

This study was conducted in purposively selected West Godavari district of Coastal Andhra Pradesh in 3 mandals (Jeelugumilli Polavaram and Buttayagudem) where Koyas are predominantly inhabitated. Two villages from each of selected 3 mandals (Bothappa Gudem, Puchika Padu, Kondrukota, Chilakaluru, Cheemalavari Gudem and Doramamidi) were selected. Fifteen farmers from each village i.e., total 90 farmers, 30 each from small, medium and large categories were selected on the basis of herd size. To study the superstitious and primitive beliefs pertaining to cattle, the researcher collected a list of such beliefs in consultation with elderly tribals of the study area, educationists and social workers of Integrated Tribal Development Agency (TDA), K.R. Puram. With the help of a schedule developed for the purpose, an effort was made to ascertain how many of these beliefs are held by the tribal farmers of three mandals under study. The beliefs were rank ordered after analysis.

Folk beliefs associated with dairy farming

1. Neglect of religious practices makes super natural power angry

It was found that 75.48% of the tribal dairy farmers had the belief that neglect of religious practices makes super natural power angry.

This practice has no scientific basis, but is being passed on form one generation to another.

2. Sacrifice is desired by deities

About 72 per cent of the respondents believed in that and ranked it second in the list of folk beliefs. The tribals believed that offering sacrifices to deities shall appease them so as to maintain the well being of their families and cattle.

The idea behind the continuance of this practice sounds illogical and it has got no relevance in present times.

3. Animal does not get satisfaction through Artificial Insemination

It was surprising to note that 51.06% of the respondents held this belief inspite of the massive efforts of the Government to popularize cross breeding programmes to improve the genetic potentiality of non-receipt breeds.

Tribals believe that it is a sin as it deprives cows and buffaloes to have normal sexual pleasure. Moreover, they are of the opinion that Artificial Insemination (AI). is something unusual and producing calves through injection will spoil their cows. They believe in the purity of breed and consider crossbreeds through Artificial Insemination (AI) as impure animals.

This belief is valid to some extent, as Artificial Insemination cannot stand as a substitution for copulation in terms of normal physiological process. But, Artificial Insemination is a practice, which need to be encouraged.

4. Evil spirit causes death to animals

This belief is held by 24.42% of the tribal dairy farmers. Though there is a slight shift in the belief structure of the tribals now-a-days, still some of them held this opinion. Tribals generally believe that behind every disease there are the hands of some evil spirit. Such beliefs are deep-rooted and inferential.

Table : Folk beliefs (superstitious) held by dairy farmers regarding dairy farming among Koyas in A.P.

Sl.No.	Folk beliefs	Frequency	Percentage	Rank
1.	Neglect of religious practices make super natural power angry	68	75.48	I
2.	Sacrifice is desired by deities	65	72.15	II
3.	Sight of specific women (widow) spoils the milk yield of the animals or spoils the animal	59	65.49	III
4.	The placenta of the animal after parturition when hanged to the 'milk plant' helps in boosting the milk production of that animal	54	59.94	IV
5.	When tribals sell their goat, sheep or cattle they pull out few hairs from the waist of animals considering it auspicious	49	54.39	V
6.	Animal does not get satisfaction through artificial insemination	46	51.06	VI
7.	The tying of 'magic thread' given by tribal priest to the neck of animals helps them overcome disease epidemics	42	46.62	VII
8.	Taking milk and buttermilk reduces the intoxicating effect of toddy	36	39.96	VIII
9.	The Coughing of buffaloes forecasts rain	27	29.97	IX
10.	Evil spirit causes death of animals	22	24.42	X

Scientifically this belief does not stand to critical investigation.

5. When tribals sell their goat, sheep or cattle they pull out few hairs from the waist of animals considering it auspicious

This belief was held by quite a sizeable number of tribals (54.39%) occupying 5th position in ranking given by tribals. We can infer from this that tribals have very strong belief, creating difficulty to extension agencies to change them by extension education. Tribals consider livestock as wealth still in their possession by keeping some hairs with them they also believed that the luck of their family would desert them if they do not do this.

6. Sight of specific women (widow) spoils the milk yield of the animal or spoils the animal

About 65 per cent of the total respondents believed in this and ranked it at 3rd position of the total folk beliefs. It is a belief transmitted over generations. The woman in reference falls under the unfamiliar object to the milking animal. This has nothing to do with the spoilage of the animal and the reduction of milk yield.

7. The coughing of cows forecasts rain

About 30 per cent of the tribal dairy farmers held this opinion. On enquiry, tribals were not able to provide any reason for such belief.

Coughing occurs due to some irritant in the respiratory system of the animal that may be bacteria, virus, dust particles, harmful genes or sudden change in the weather. It might be a coincidence that rains followed coughing of animal, but it has no scientific basis.

8. The placenta of the animal when hanged to the 'milk plant' helps in boosting the milk production of that animal

This opinion was held by 59.94% of the total respondents among the tribals. Tribals believe that hanging the placenta of the animal to the milk plant will boost the milk yield of that animal. Though it does not stand upto scientific reasoning it is being still practiced in this area.

9. Taking milk and buttermilk reduces the intoxicating effect of toddy

A sizeable portion of the respondents (39.96%) held this opinion. Generally tribals in that area do not consume milk and butter milk as they believe that it reduces the intoxicating effect of toddy and toddy happens to be the favourite choice of tribals.

10. The tying of 'magic thread' given by tribal priest to the neck of animals helps them overcome disease epidemics

Nearly 46 per cent of the tribal respondents were of the opinion that ' magic thread' keeps the animals away from diseases. A local priest ties the ' magic thread' to the neck of the animals whenever the animal is ill. Tribals believed that this could save the animal from its illness.

It was observed that the majority of the farmers adhered to the existing folk beliefs in this tribe. They were highly resistant to change with regard to their folk beliefs. These folk beliefs seemed to be deep rooted in their culture. Based on the study it was recommended that (i) The spread of civilization and modernization has been checked by the numerous hills and plateaus in the area. Thus, tribals are still following religious practices and worshipping their deities with mixed feelings of fear and supplications. Hence, to overcome the fear of tribals about supernatural beliefs, a flexible programme of science education to explain the nature and man's place in it may be implemented in the area. (ii) The priest was dominating the scene in remote areas due to his knowledge about herbal plants used in the treatment of human beings as well as animals. The developmental agencies must try to build up a rapport with the 'Priest" and acquire knowledge of various herbal medicines, which may be useful for human as well as livestock. (iii) Efforts are needed to educate the tribals including their folk beliefs, in changing their attitude favourable towards dairy farming and in exposing them to various communication sources and institutions operating in the area.

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